NEW SOUTH WALES.

DEPARTMENT OF MINES AND AGRICULTURE.

GEOLOGICAL SURVEY.

E. F. PITTMAN, A.R.S.M., GOVERNMENT GEOLOGIST.

MINERAL RESOURCES.

No. 9.

REPORT

ON THE

YALWAL GOLD-FIELD.

BY

E. C. ANDREWS, B.A.,
GEOLOGICAL SURVEYOR.

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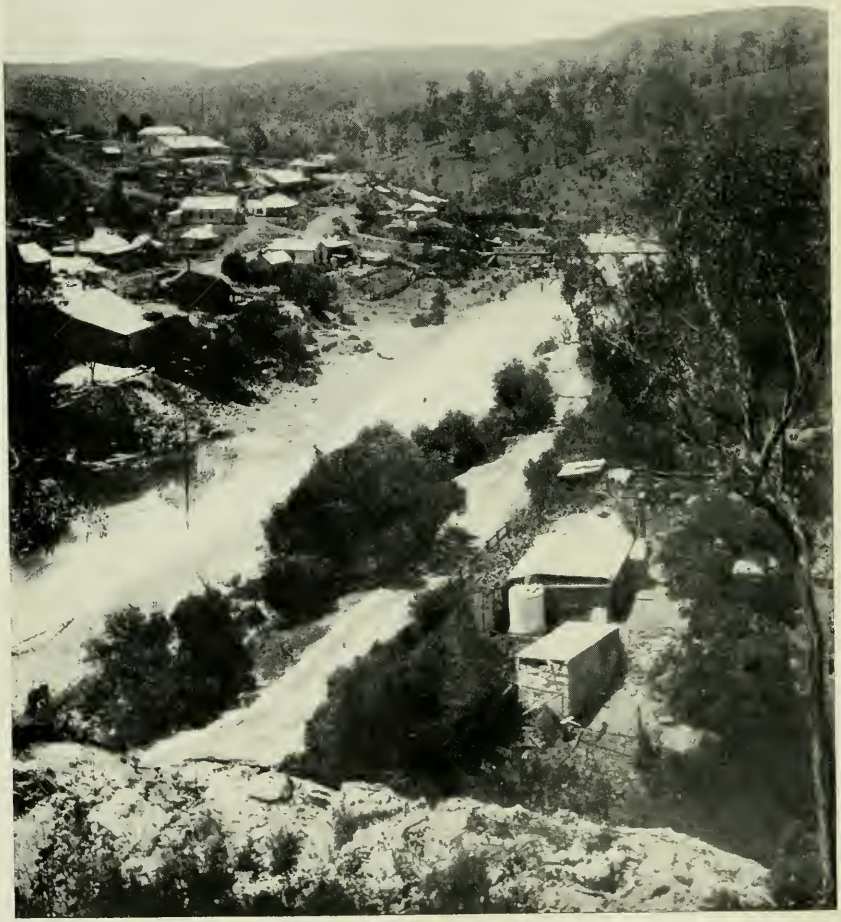

View of Yalwal from the South.

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Geological Survey Office,
Department of Mines and Agriculture,
Sydney, 17 October, 1901.

Sir,

I have the honor to submit for publication Report No. 9 of the Mineral Resources Series, being a description of the geology of the Yalwal Gold-field, by Mr. E. C. Andrews, B.A., Geological Surveyor.

Gold-mining operations have been carried on at Yalwal for about thirty years, and although some extremely rich patches of stone have been extracted from such mines as The Pinnacle, The Caledonia, The Pioneer, and The Homeward Bound, it is chiefly upon the low grade ores of the field that the gold-mining industry has had to depend.

The Yalwal field is of interest, owing to the fact that the mining and treatment of auriferous ores has been effected here at a lower cost than in any other part of the State ; one of the principal reasons for this is that the ore can be extracted in open cuts or quarries at a very low rate. The gold occurs chiefly as impregnations in indurated slates, quartzites, and conglomerates of Devonian age , and although minute quartz veins are occasionally visible in these, it is found to be more economical to extract and treat the whole of the material rather than to attempt to pick out the richer portions.

The Homeward Bound and Pioneer Mines have been able to pay their way for some years by treating ore of exceptionally low value ; and in view of this fact it seems probable that good profits could be obtained if these mines were worked on a much larger scale, as is done, for instance, with analogous ores at the Treadwell mine, Alaska, U.S.A.

EDWARD F. PITTMAN,
Government Geologist.

The Under Secretary for Mines and Agriculture.

SYNOPSIS OF CONTENTS.

PREVIOUS REFERENCES TO THE YALWAL AND GRASSY GULLY GOLD-FIELDS.

(1.) In 1852, Mr. A. Mackay, Commissioner of Crown Lands, reported on the geology of Yalwal.*

(2.) The Rev. W. B. Clarke, F.R.S., also reported on the Yalwal Gold-field at various times between 1860 and 1872.†

(3.) Mr. E. F. Pittman, Government, Government Geologist in 1883, made a report also on the Yalwal field ‡

(4.) Mr. J. B. Jaquet, Geological Surveyor, reported on a gold-bearing rhyolite at Grassy Gully.§

(5.) Mr. W. H. J. Slee, Chief Mining Inspector, reported on the Bundundah reefs.‖

(6.) Various Wardens' reports are to be found in the Annual Reports of the Depart, ment of Mines for the years 1878–79, 1880–81, 1887–88, 1888–89, 1889–90-1890–91, 1891–92.

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* Southern Gold-fields, pp. 39 and 40. † *Ibid.*, pp. 40–45. ‡ Ann. Rept., Dept. Mines for 1883-84 pp. 159 and 160. § Records Geol. Survey N. S. Wales, 1900, vii. p. 17. ‖ Ann. Rept., Dept. Mines, N. S. Wales, for 1889, p. 134.

INTRODUCTION.

Many of the gold bearing areas in New South Wales are closely connected with granite masses of Carboniferous age.

The main mountain makers of the Cordillera of New South Wales (as also of Queensland) are Carboniferous rocks of basic granite types, and the auriferous areas skirting these masses are more or less dependent on them for their gold supply.*

The gold may be contained in the granite or felsite itself; it may exist throughout the contiguous strata in veins caused by intrusion of the igneous masses, and subsequently filled by circulating mineralised waters; or the gold, under the influence of the igneous masses, may be segregated from the strata themselves into veins or pockets.

Yalwal and Grassy Gully appear to be additional examples of this influence of Carboniferous (?) granitic masses.

In Yalwal itself, the gold, though not mined for in the granite, is yet in such association with it as to suggest its influence.

At Grassy Gully, five miles north of Yalwal, the gold-bearing reefs are contained in an old rhyolite, which exhibits traces of flow structure.†

The rough and mountainous character of the country made Yalwal difficult of access in former times. Even at present the road down the mountain leading to the township contains a grade of 1 in $4\frac{1}{2}$ near the summit. A new road, with a grade of 1 in 12, is almost completed, and this will benefit the Nowra-Yalwal traffic considerably.

Hitherto Grassy Gully has been heavily handicapped for the same reason, although a new road, almost completed to Burrier, will give the residents access to the outer world. All these means of communication with Nowra will make for progress in this district.

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* Address delivered to Royal Society of N. S. Wales, September, 1900, by Prof. T. W. E. David, F.R.S.
† J. B. Jaquet, Records Geol. Survey, N. S. Wales, 1900, vii p. 17.

The map of Yalwal Gold-field accompanying this Report is fairly accurate with respect to the central portion. The junctions of the sandstone with the granitic rocks to the north-west and south-west of the map are, however, approximately correct only. This is due to the broken nature of the country, and the scrubby character of the vegetation.

I desire here to cordially thank Mr. A. F. Mixner, manager of the Homeward Bound Mine; Mr. V. Petherick, the former manager of this property; Mr. I. I. Chapple, manager of Mr. A. Hay's properties; Mr. C. Potts, B.A.; Mr. John Maclean, of Nowra; Mr. Durkin, manager of Grassy Gully Mine; Mr. A. Hielman; Mr. H. Martin; Mr. J. Sivewright; Mr. G. Davidson; and many others, who have most courteously volunteered both help and information.

The maps and sections, were prepared by Mr. O. Trickett, L.S., of the Geological Branch.

History of the Development of Mining at Yalwal.

In 1852, Mr. A. Mackay, Commissioner of Crown Lands for the County of St. Vincent, communicated with Mr. J. R. Hardy, Commissioner of Crown Lands, concerning the geological and auriferous character of the Yalwal District.*

During various periods between 1860 and 1872, the Rev. W. B. Clarke, examined the district under consideration in some detail.†

In these earlier days the whole country stretching from the mouth of the Yalwal Creek to the head of the Yarramunmun (known as Sassafras), belonged to W. Elyard. Toorooroo, situate at the junction of the Danjera and Yarramunmun Creeks, was the head station; and close to this spot, early in 1870, the first real efforts at prospecting were undertaken.

The original prospectors were Messrs. J. Sivewright, J. Brakewell and S. Donovan. The site chosen for working the alluvial was along the Danjera, immediately above its confluence with the Yarramunmun. Here 350 feet of boxes for sluicing operations were set up. From this alluvial claim, J. Sivewright, with six men on wages, recovered 1½ to 2 ounces of gold per week.

The great flood of 1871 washed away all the sluicing apparatus, and caused suspension of operations for a time.

In the same year, and a little higher up the creek, J. Sivewright and E. Curtis discovered reef gold *in situ*. The spot is now known as "The Pinnacle" or No. 1 Claim. The stone was found on the summit of a bluff rising some 150 feet out of the creek.

Prospects were crushed in a saudstone mortar.

A parcel of 2 cwt. was sent to Mort's, in Pitt-street, with a result of 7 dwt. per ton from surface stone. This dismayed the prospectors for a while, but on Sivewright's return from Queensland in 1873, he essayed a second time the working of the Pinnacle.

From a small parcel of ore 30 oz. of gold were obtained. For four months' work the result was 140 oz. of gold.

The stone was carried down the bluff to the creek, and dollied there by means of crowbars working in nail cans. By preliminary roasting of the ore each man was enabled to crush 56 lb. weight per day. The gold was then amalgamated dry after passing the crushed material through very fine sieves. The prospects being still payable, one of Dr. Beer's one stamper spring machines was procured. This gave a strike equal to 2 cwt. One man with this machine could crush half a ton of stone per week. The returns were from 24 to 30 oz. per ton, extracted from hard clean quartz.

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* W. B. Clarke, Southern Gold-fields, pp. 39–40. Also Appendix I to this report. † *Ibid*, pp. 40-45. Also Appendix II.

Shortly afterwards, a 3-head battery, constructed at Lutton's, supplanted Dr. Beer's machine. With the improved machinery, 3 to 4 tons of stone were crushed every week.

In 1871, alluvial gold was obtained in Sawpit Gully. The metal was coarse in character, but did not appear to occur in payable quantities.

E. Aldis and J. Caddle discovered gold in 1872 from surface prospects on the property now known as the Pioneer. The stone was treated at the creek below, but the gold was of too fine a nature for the crude methods of saving employed, and prospecting was discontinued on this claim for a period.

About the year 1874 Michael Harvey and another found gold on the present Homeward Bound Claim.

About the year 1875 J. MacArthur & Company erected a 5-head battery, driven by an engine of 8-horse power. It was an odd five of an original 30-head battery, procured for the Upper Shoalhaven River.

A 16-ton parcel was made up from the Homeward Bound Claim, and crushed at this battery. The result was 1 oz. 6 dwt. per ton.

J. Sivewright and Party hired this plant for their work, its crushing efficiency being 40–45 tons per week.

Gold in the stone (the Pinnacle) varied from 1–3½ oz. per ton. The Pinnacle owners used this plant for 12 months. The property was then taken up by a company of 24,000 £1 shares, with 12,000 paid up to £1.

The Homeward Bound Claim was then taken up by T. Thorburn and Party. In 1887 they bought a 10-head battery from J. MacArthur & Company, which had been originally used for public crushings, and fixed it on the site of the present cyanide plant. A shaft was sunk for 50 feet on a quartz vein, but later, finding that the gold was scattered in "stringers" throughout the country, the company excavated a large chamber in the vicinity of the quartz vein. More gold was found from surface crushings near the original workings. The surface was then broken through and the open cut system established. The country was worked north and south for gold.

As the success of the Homeward Bound Claim became assured, another trial was made on the adjoining Pioneer property.

A shaft was sunk on a small quartz "leader," and good returns were crushed from the same. Stoping was resorted to, and several crushings taken from both shaft and stope.

Prior to 1885, the original company (consisting of T. Thorburn, J. Maclean, and 30 others) had sunk the shaft 60 feet.

The claim next to the Pinnacle on the north, and known as the Eclipse or No. 2, was taken up by J. Maclean and Party about the year 1874.

A 10-head battery was erected in 1878. This was purchased from Dr. H. J. Tarrant. The second crushing gave a result of 7 oz. gold per ton from 761 tons of ore.

In 1881, £2,795 worth of gold was extracted from this claim.

In 1880, E. Curtis and E. Fletcher discovered gold in a claim north of the Eclipse property, and known as the Poor Man.

In February, 1881, a 15-head battery was procured for the Pinnacle Company from the Atlas Works. This company at the time mentioned was known as the Yalwal Quartz-mining Company.

The "Star" lease was taken up by Kennedy, Maclean and Party in 1883. The shareholders numbered eighteen. £2,000 were spent in driving tunnels without any return.

This property immediately adjoins the Homeward Bound lease to the south, and it was the prosperity of the latter which urged the lessees of the Star to take up and explore the claim.

Accordingly three tunnels were put in as closely as possible to the southern boundary of the neighbouring property. The tunnels were driven vertically above each other in the rough hillside which composes the claim.

The lower tunnel was started in 1883 and completed in 1885. Its length is 450 feet and its direction easterly. This is near the level of the creek.

The upper tunnel was driven by Peter Matson in 1887, under the sandstone capping of the hill, and 350 feet above the level of the creek. The total length driven was 200 feet.

From this part of the claim 10 tons of stone were extracted in 1893, yielding an average of 7 dwts. of gold per ton.

A middle tunnel was also driven about 100 feet below the upper one between the years 1890–92. The total length driven was 350 feet. Prospects amounting to 10 and 12 dwt. per ton were obtained from this working.

Prior to 1885, the work on the Pioneer consisted of a shaft some 50 or 60 feet deep, and a few small surface workings.

Mr. J. Hanson, in 1890, bought the property for £15,000. Stone taken from various spots on the lease gave satisfactory results, individual crushings yielding returns as high as 3 oz. per ton. Three quarries, or open cuts, exist on this property. The two westerly ones represent earlier exploitings for gold. The eastern one, shown on the map as continuous with the Homeward Bound open cut, is of more recent date than the others.

A tunnel was driven nearly 900 feet into the hill in 1891. In 1901 the tunnel was carried a further 100 feet. The idea was to test the hill, and to connect the open cuts with the battery.

Another tunnel at a higher level was driven 400 feet to prove the property, and to connect the workings with the main pass.

A 40-head battery was erected by Mr. Hanson in 1891.

The property was then resold to a Nowra syndicate, having practically the same *personnel* as the original company. This was in 1892.

The approximate cost of erecting the mining plant and in developing the property was £27,000.

The Caledonian Claim was taken up in 1885, and amalgamated with the Star in 1887.

In that year, prospectors found an auriferous vein in the first-named property. A 5-head battery for public use was employed, a road being cut round the hillside to convey the ore to the battery. One hundred tons were crushed from the lease for a return of £500, the maximum yield being 6 oz. per ton.

The road just mentioned passed through what is now known as Underwood's Cut, splendid stone lying unnoticed on the roadside for four or five years.

The mine lay idle until 1892, in which year W. Underwood and R. Johnson took the mine on tribute. Opening up a small quartz vein showing in the roadside at Underwood's Cut, they crushed, at the first trial, stone varying from 23 to 30 oz. of gold per ton. From this vein, varying from 3 to 9 inches in width, they crushed £3,500 worth of gold in three months.

One parcel of 34 cwt. yielded 750 oz. of gold. This rich stone was, from all accounts, very unpromising in appearance; only on being crushed or scratched did it reveal its true nature. The tributers, apparently, then lost the vein against a "floor."

Fletcher Brothers then took the property on lease from the original tributers. Following the "floor" up, they again came on the vein, which proved richer than before.

Fletcher Brothers won £6,500 worth of gold as the result of their tribute.

These latter then closed in with an offer of £950 from the original company, who, in a short space of time, extracted gold to the value of £6,900.

Other veins, running parallel to the direction of Underwood's Cut and known as Ison's and Sandeman's Cuts, were worked also with success, the stone varying from 2 to 6 oz. of gold per ton.

In 1886, the Eclipse Company, having excavated a system of large chambers from an extensive lode formation, connected the same with their battery by means of a long and sinuous tunnel.

From 1882 to 1889 the Homeward Bound Company crushed with a 10-head battery.

In 1885, £5,132, and in 1887, £6,105 worth of gold was won by the company.

After 1889, the property was sold to the Homeward Bound Gold-mining Company, who erected twenty head of stampers (exclusive of the original 10-head battery).

In 1891, another twenty head of stampers was added, and two years after the original 10-head battery was incorporated with the 40-head, to form a 50-head battery.

From June, 1893, to December, 1896, the mine was hampered considerably, sometimes closed altogether, owing to litigation.

This threw the miners out of employment, and an alluvial prospect being found by Middleton and Prince, in a shaft 15 feet deep, in Sawpit Gully, a small rush took place in 1893.

Thirty men were soon at work, the gully being rushed, although the ground was leased. £2,500 worth of gold was extracted in eight months. Nuggets varying in weight from 15 dwts. to 2 ozs. were found.

In 1894, J. Sivewright and T. Mason attempted to sink through a vesicular dolerite at Grassy Gully (five miles north of Yalwal) for alluvial gold.

The following year, R. Ison and Charles Moffatt discovered payable gold at the same locality (Grassy Gully).

This was in close proximity to the sandstone cap which forms the ridge between the Shoalhaven River and Yalwal Creek. The auriferous belt was found to extend in a north and south direction through a rhyolite flow, and the country was rapidly taken up over a narrow area exceeding a mile in length.

In 1896, a great number of the minor properties belonging to the Yalwal area were worked with varying success.

In this year 113 tons of stone were crushed, for a return of 188½ ozs. of gold, from "The Golden Quarry" (G.L. 27.28).

In the early part of February, 1898, a cyanide plant was erected by the Pioneer Company.

During the same month, the Homeward Bound Claim was placed under new management. Mr. Petherick came into charge, and, in view of the low class of the ore, he decided to erect an experimental cyanide plant.

Mr. A. F. Mixner had charge of the cyanide plant. It worked so well that a much larger plant was erected, which ultimately became the mainstay of the mine.

In November, 1900, Mr. Mixner was appointed general manager.

Moffatt, one of the discoverers of Grassy Gully gold, took up a lease in this locality in 1895, and sold, shortly afterwards, to the Anglo-Australian Company. The lease was forfeited in June, 1898, and taken up by Messrs. Hanson and Barron, by whom it was worked for nine months.

It was then sold to Mr. W. H. E. Lovely and Party, and worked for six months.

In January, 1900, it was formed into the Grassy Gully Gold-mining Company, with P. Durkin as manager.

The mine had been sunk to 185 feet in June, 1900.

A 10-head battery and a Wilfley vanner were erected in September, 1900.

Summary.

1852. Report on Yalwal, by Mr. A. Mackay. Reports by Rev. W. B. Clarke, F.R.S.
1870. Prospecting for alluvial by J. Sivewright and Party.
1871. Abandonment of sluicing operations. Alluvial found in Sawpit Gully. Discovery of gold *in situ* (Pinnacle).
1872. Gold discovery in Pioneer Claim.
1873. Pinnacle worked a second time.
1874. Gold discovered in Homeward Bound Claim. Eclipse Claim taken up (?).
1875. Erection of 5-head battery for public crushing purposes.
1878. Ten-head battery erected for Eclipse Claim.
1880. "Poor Man" discovered.
1881. Fifteen-head battery procured for Pinnacle.
1883. "Star" lease taken up.
1885. "Caledonian" lease pegged out.
1887. Homeward Bound Company purchased 10-head battery.
1889. Additional 20-head of stampers erected for Homeward Bound Company.
1890. Mr. J. Hanson purchased Pioneer property for £15,000. Forty-head battery erected for Pioneer property.
1891. Pioneer Lower Tunnel driven 850 feet.
1892. Additional 20-head battery erected for Homeward Bound Company. The old 10-head included, bringing total up to 50-head. W. Underwood and R. Johnson crushed £3,000 worth of gold in three months from Caledonian Claim. Pioneer property rebought by original shareholders.
1893. £2,500 worth of alluvial gold won from Sawpit Gully.
1894. T. Mason and J. Sivewright attempted to sink through dolerite for alluvial in Grassy Gully.
1895. C. Moffatt and R. Ison discovered gold at Grassy Gully. "Grassy Gully Mine" started. Pioneer and Caledonian properties yielded £18,565 worth of gold. 4 tons crushed from Caledonian for 1,664 oz. of gold.
1896. Numerous minor properties worked.
1898. Cyanide plant erected for Pioneer Claim. Experimental cyanide plant erected for Homeward Bound Claim.
1900. Present Homeward Bound cyanide plant erected (March). Ten-head battery and Wilfley vanner erected at Grassy Gully.

Physical Geography.

Yalwal, by road, is about eighteen miles west of Nowra. It is approached from the latter by crossing a couple of ridges, and is situate at the base of a gorge, through which the Danjera Creek flows in its passage to the Shoalhaven River.

For a distance of seven miles out of Nowra, the road makes a gradual ascent for about 600 feet. Saltwater Creek is then crossed. Thence to the 16-mile peg, the road follows a narrow ridge, at which point a descent is made of 900 feet to the junction of the Danjera and Yarramunmun Creeks.

Drainage System.—The Shoalhaven River has a northerly course from Braidwood to Bungonia. A little below the latter place, however, it alters its direction sharply to the east. Sweeping clean through the mountainous belt between Bungonia and the coast, it persists in its new course until it reaches the sea, eighty miles distant. In this easterly direction it drains the whole of the Yalwal District, and takes in also the waters of the Kangaroo River.

The country is very rugged and broken, especially to the west of Yalwal. The district represents a thoroughly dissected plateau with ridges or "razorbacks" marking the extensive denudation to which the old upland has been subjected, and, at the same time, separating the various creeks, which feed the Shoalhaven, from each other.

From an eminence immediately behind the village of Yalwal, and 1,250 feet above the Danjera Creek, the leading features in the topography can easily be made out.

To the north and west the Shoalhaven River has eroded an old sandstone plateau to a marvellous extent. From the spot where it gathers in the waters of the Kangaroo River (and also far above this point) to its junction with the Yalwal Creek, bold escarpments, 2,000 feet and more in height, with cliffs 1,000 feet high in places, mark the course of the cañon-like valley of the main stream.

A little below its junction with the Yalwal Creek, the river spreads itself over the flatter country caused by the retreat of the hills from the stream. On the east bank, the huge pile known as the Cambewarra Mountain (a portion of the coast range), 2,000 feet in height, divides the waters of the main stream from its large tributary, the Kangaroo River. This highland supports luxuriant growths of grass, which constitute one of the sources of wealth of the district. Thence towards the sea the mountains dwindle in height, and with the exception of Coolongatta, a rounded eminence, 1,000 feet high, they become less and less separable from the gentle undulations of the surrounding country.

The creeks in the immediate neighbourhood of Yalwal are the Danjera (Plate II), the Right Arm or Bundundah, the Ettrema, and the Yarramunmun. These have approximately parallel courses for considerable distances, finally joining the Yalwal near its confluence with the main stream.

The sandstone cap constituting the former plateau at one time extended in unbroken continuity from the present coast line through Yalwal and across the Shoalhaven River. This has since been trenched or dissected so thoroughly in the vicinity of Yalwal by the creeks just enumerated that their courses are marked by gorges varying from 1,000 to 1,500 feet in depth, the summits of their various watersheds being represented merely by lines of cliffs in many places not more than a chain in width.

The cap comprises two series of hard sandstones, with soft intercalated shales. These harder beds divide the district into two "platforms" or "terraces." The upper some 200 feet thick and from 1,200 to 1,400 feet above the creeks, forms precipices over which the pioneers of the district found it difficult to force a way. Also a lower platform 500 feet below the upper one, and some 150 feet in thickness. This also faces the valleys in precipitous manner.

The upper series is broken here and there by lower gaps or passes allowing ingress and egress to and from the valleys.

The hard strata underlying the sandstone cap are exposed at a general height of 500 feet above the creeks. These, unlike the sandstone (which forms "terraces"), weather out into long hard spurs, which advance to the creeks from the cliffs above, after the manner of great buttresses.

These platforms or "terraces" are to be expected in greatly denuded horizontal strata, where the beds are of varying hardness. A still later phase of denudation is the "mesa" stage, when creeks have so intersected a plateau as to leave isolated flat-topped hills with precipitous sides. Several examples of these occur in the vicinity of Yalwal. They are about 1,000 feet in height, have high cliffs surmounting very steep slopes, and possess quite flat tops, a few acres only in extent.

General View of Danjera Creek from the Pinnacle Claim. Fioneer and Homeward Bound Batteries in the middle ground.

The appearance of the Devonian rocks conforms also to the generally observed order of phenomena in the weathering of strata nearly vertical, containing beds of varying hardness, *i.e.*, rough spurs with dyke-like formations (representing the harder layers), running parallel to the strike.

The valleys widen in and out most capriciously. The trend, however, of the minor streams is nearly north and south.

Five miles above Yalwal, along the Danjera Creek, bluffs occur nearly 1,000 feet in height, composed of red granite and rhyolites.

Meteorology.—Yalwal, although eighteen miles only from Nowra, experiences intense heat in summer. This is due to its being cut off from sea influences by a mountain ridge, 1,100 feet high, rising immediately to the east of the village and trending so as to intercept any sea breeze; to the narrowness of the gorge itself in which the village is situated; and to the fact of its being less than 200 feet above sea level. On exceptional days the shade temperature reaches 115° Fahrenheit.

The rainfall varies from 40 to 50 inches per annum.

Vegetation.—The granite areas contain great escarpments supporting a very meagre and stunted vegetation.

The sandstone below the upper line of cliffs supports dense growths from six to ten feet high, through which it is difficult to force one's way. The lower gullies, enclosed by the spurs of Devonian strata, are full of myrtle and allied growths, while the basic igneous rocks may at times be traced by the luxuriant crops of grass they support when cleared of timber.

General Geology.

The surface of the Yalwal District being much broken, very little difficulty is experienced in ascertaining the various sedimentary and igneous rock junctions. They are, however, obscured in many places owing to the great amount of talus derived from the Permo-Carboniferous sandstone, and the thick scrub-growths that fill the gullies.

The geological formations of this locality are as follows:—

1. Recent and Pleistocene—Alluvium and river terraces.
2. Permo-Carboniferous—Lavas and tuffs, upper marine sandstones.
3. Carboniferous—Granites and quartz-felspar porphyries.
4. Devonian—Dolerite sills, rhyolite lavas, dolerite lavas, slates, quartzites, conglomerates, schists, and shales.

1. *Recent and Pleistocene.*—To this date belongs the period of deposition of alluvium in the various creeks about Yalwal. The Shoalhaven is said to possess river "terraces" or marks of former river levels. These may be referred to this period also.

2. *Permo-Carboniferous.*—The formations of this period consist of a huge covering of sandstones, grits, and mudstones, which formerly extended across the whole of the district. The older underlying formations have been exposed by the erosion of this Permo-Carboniferous crust.

To understand the geological position of this sandstone cap, a brief *resumé* of conditions obtaining in New South Wales during Permo-Carboniferous times is inserted here:—

The Permo-Carboniferous period was the great coal making epoch of the southern hemisphere, and is further remarkable by reason of great alternating periods of heat and cold (glacial periods) which occurred shortly after the Carboniferous period.

In New South Wales, the period is divided into several great divisions.

The oldest beds comprise *The Lower Marine Series*, consisting of various sedimentary rocks containing marine fossils. This series is 4,770 feet in total thickness, and contains abundant evidence of glacial action in its lower beds.

The *Greta Coal Measures* were then laid down. The equivalent of these in the South Coast District is the *Clyde Seam.*

To this succeeded the *Upper Marine Beds*, a mass of sedimentary rocks 5,000 feet in maximum thickness. Especially well are these beds developed in the Maitland District. Great periods of cold occurred also during the deposition of these beds.

It is to this latter series that the Yalwal sandstones belong. They lie directly on the older Carboniferous granite and Devonian inliers with no intervening coal seam (Clyde) ; since the granite hills represented high land during the deposition of the Greta or Clyde coal.

Subsequently the great *Maitland* and *Newcastle Coal Measures*, with a total thickness of 3,900 feet, were deposited. Both of these are supposed to have coalesced to the south to form the *Bulli Seam.* This also is absent from Yalwal. If present it would form a cap to the sandstone above the Yalwal Trig. Station.

After the deposition of the coal measures a great period of volcanicity supervened. The lavas and tuffs of Cambewarra and Kiama are expressions of this volcanic activity.

3. *Carboniferous.*—To this period the granites and quartz-felspar porphyries of the district may be assigned.

4. *The Devonian.*—The formations belonging to this period consist of rhyolite and basic lavas, basic sills, and various metamorphosed and folded strata.

The Permo-Carboniferous sandstone, although subjected to extensive denudation, still occupies by far a greater extent of the surface rocks than those of Carboniferous and Devonian age. Only at the bases of the ravines can the latter be examined, with the exception of a few granite and rhyolite hills lying some six miles to the south and south-west of Yalwal. These were the more prominent features of the landscape in early Permo-Carboniferous times, just prior to their sinking below the sea in the Upper Marine period. Even these higher points are, however, but partially exposed.

It will thus be seen that our knowledge of the formations older than the Upper Marine are confined to exposures found in the lower parts of the various gorges of the district.

Yarramunmun Creek.—In following this watercourse above its junction with the Danjera, a narrow belt of contorted strata is found underlying the sandstone as far as Dean's Flat. A valley existed here in the Pre-Upper Marine times, and sandstone alone is found filling the basin.

The Danjera Creek at Yalwal exposes numerous belts of basic igneous rocks, whose strike conforms to that of the contorted strata they are associated with. Two miles above the village these open out into steep grassy hills abutting on to the creek, while immediately alongside of these rise rough, broken hills of quartz-felspar, porphyry, and granite.

Four miles above the village the granite advances across the creek, and occupies most of the valley slopes.

A couple of miles higher up still, great precipitous faces of rhyolite succeed to the rounded masses of the coarser granite. In places these rhyolite masses rise nearly 1,000 feet above the creek, and present the appearance of the rougher granite gullies of New England.

The formations exposed by the Right Arm or Bundundah Creek are repetitions, mainly, of those found in the Danjera Creek. Amygdaloidal lavas are very plentiful. Quartz-felspar porphyries are in evidence toward the head of the creek. The lower five miles of the creek sides consist of a fine grained and very siliceous granitic type of rock.

The Yalwal Creek slopes from their start as far down as Mackenzie's Station, consist almost solely of granite and porphyries. The land at the station itself is a series of steep, well-grassed downs, consisting of vesicular basic rocks, with long lines of acid rocks either alternating with or intrusive into the basic rocks.

Thence to the Shoalhaven the underlying rocks occur as bold escarpments of contorted strata and felsite lavas. Especially well are these seen near the junction of the Ettrema and Yalwal Creeks. Cliffs several hundreds of feet in height expose sections of strata bent into almost perfect folds, standing out in sharp contrast with the overlying horizontally bedded sandstone.

Near the Shoalhaven the sandstone encroaches on the Yalwal Creek, and occupies even the lowest part of the gorge.

The older formations between Yalwal Creek and Grassy Gully are almost entirely hidden beneath the sandstone cap.

At Grassy Gully itself, the older rocks are exposed in part and rhyolite flows associated with basic amygdaloidal rocks occupy the gold mining area.

It will thus be seen that (*vide* map) a very large area of the underlying rocks consist of rhyolites, quartz-felspar porphyries and granites. They may be considered as extending from the village west and south-west right under the sandstone across the Right Arm Creek, and northwards for miles along the Yalwal Creek.

A considerable area is occupied also by basic igneous rocks.

These basic rocks, intrusive or as contemporaneous flows, consist of amygdaloidal and compact ophitic dolerites and basalts in an advanced stage of decomposition.

The order of succession appears to be as follows:—First, a series of Devonian mudstones, sandstones, and allied rocks were laid down.

Intermittent periods of intense volcanicity occurred at this period, during which immense rhyolite and basic flows were poured forth from various local centres.

The higher members of the Devonian series consist of soft shales, grits, and soft and hard brown tuffaceous material containing numerous *Lepidodendron* remains. With these are associated several sheets of very vesicular dolerite, numerous dolerite sills, and smaller rhyolite flows.

The dolerite sills may be contemporaneous with some of the interbedded sheets, or they may be of later origin.

At a much later date, probably in Carboniferous times, quartz-felspar porphyries (typically as vertical bosses or tongues) and red granites of most pronounced acid affinities made their appearance.

To this date, also, probably belongs the age of the auriferous deposits.

The whole surface then suffered long-continued denudation, causing the aforetime fairly deeply-seated granite masses to stand out boldly above the general surface.

The sinking of the district was accompanied by a deposit of Upper Marine sandstone.

Subsequently the slumbering volcanic forces again came into play, and the basic lavas and tuffs of Sassafras, Cambewarra, and Kiama resulted.

The reasons for assuming these ages and the order of succession is as follows:—

The Age of the oldest Strata.—These are assigned to the Devonian, both on account of their lithological characters and their mode of occurrence.

The Rev. W. B. Clarke* placed these sediments in two divisions—

(1) An upper series containing *Lepidodendron* and *Sigillaria*. These he included as Carboniferous.

(2) A lower series composed of quartzites, slates, &c., and comprising the gold-bearing rocks. These he placed in the Silurian.

Lepidodendra obtained from Mr. Clarke's upper series have been described as follows by Mr. W. S. Dun, Palæontologist to the Survey:—"A most interesting, small-patterned *Lepidodendron*. The leaf bases vary in size from 3mm. x 2·25mm. to 4mm. x 3mm. Several specimens, however, show a more elongated form—7mm. x 4mm. The leaf cushion is well raised, about one-third along axis from the apex of the leaf-base. The print of the vascular bundle is well marked. No traces of parichnos or ligule are preserved. There appears to be no doubt that this species is new. The smaller leaf bases have much the appearance of some forms described as *Ulodendron* (without the large rounded scars). There is an apparent resemblance to forms of *L. Sternbergi* and *L. Heeri*, Nathorst from Spitzbergen. A description and figures will be published in the forthcoming "Records of the Geological Survey."

The *Sigillaria* mentioned by the Rev. W. B. Clarke has not been discovered since.

In the Eclipse and Pinnacle workings well-preserved *Lepidodendra* occur, and identical with those found in the upper beds.

The broad belts of conglomerate traversing the Pinnacle, Eclipse, Golden Crown, Usher, and Caledonian Claims are also probably closely related with the less altered conglomerates of the Jinkbilly Creek.

The evidence points, therefore, to one formation rather than to two distinct periods of deposition. The apparent break in the geological continuity is caused by altered topographical conditions occasioned by the sudden disappearance of the amygdaloids, whose presence causes steep grassy downs, and whose absence allows of rugged gullies in the slates and quartzites, and a fold in the country which has given the idea of a basin (containing *Lepidodendron* remains) in the midst of older formations.

The old rhyolites and dolerites around Grassy Gully appear to be contemporaneous with the associated Devonian strata.

Two great sheets of rhyolite lava are separated by a 2-chain wide band of very vesicular dolerite.

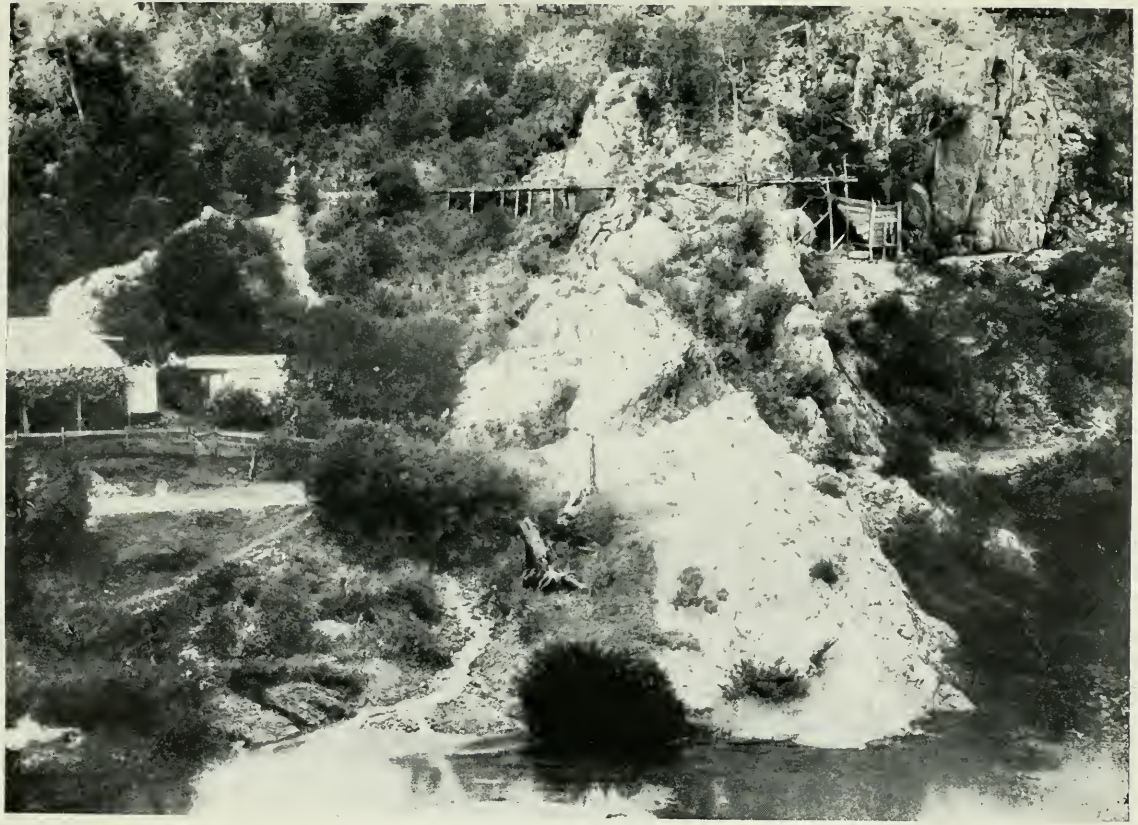
Between the dolerite and the upper sheet a thin selvage of tuffaceous mudstone and slate occurs.

The rhyolites to the south of Yalwal represent yet other enormous acid flows, or the continuation of those occurring at Grassy Gully and cut off by the granites.

Here, also, two rhyolite sheets are separated by a large dolerite sheet. Between the two a belt of basic tuffs occurs.

The banded nature and characteristic contortion flow-structure of the rhyolites, the presence of acid tuffs, the very marked vesicular character of the dolerites, the presence of basic tuffs, the intercalation of mudstones, shales, and allied rocks with the igneous rocks, and the coincidence of strike as regards both igneous and sedimentary rocks, point to great alternating submarine outbursts of acid and basic lavas in Devonian times.

* Southern Gold-fields, pp. 41, 240; also Appendix 2 to this Report.



"THE BUCK REEF." AN ALTERED CONGLOMERATE BELT NEAR THE PINNACLE CLAIM.

The Gap showing Bluffs of Upper Marine Sandstone.

The sills (?) are placed as younger members of the series, on account of their apparent origin :—

(*a*) They are unaccompanied with tuffs.
(*b*) They transgress planes of bedding in places.

The granites and quartz-felspar porphyries send out long red aplitic dykes into the surrounding strata, the rhyolites, the basic lavas, and sills alike.

Both the granites and porphyries possibly represent different phases of consolidation of a plutonic mass, and thus may be of the same age.

In this limited area we have then :—

(*a*) Alternating basic and acid lavas of Devonian age.
(*b*) Granites and microgranites of Carboniferous age.
(*c*) Basic lavas of the Permo-Carboniferous.

The alternation of acid and basic lavas in Devonian times points, possibly, to a remarkable differentiation of a common magma. What that magma consisted of is not yet evident, as no plutonic "boss" has been discovered in the district which could serve as a feeder to the various lavas of the locality.

B.—Sedimentary Rocks.

(*a*) *Recent or Pleistocene.*—As mentioned before, to this period belong the alluvial of the creeks and the river terraces (?) of the Shoalhaven.

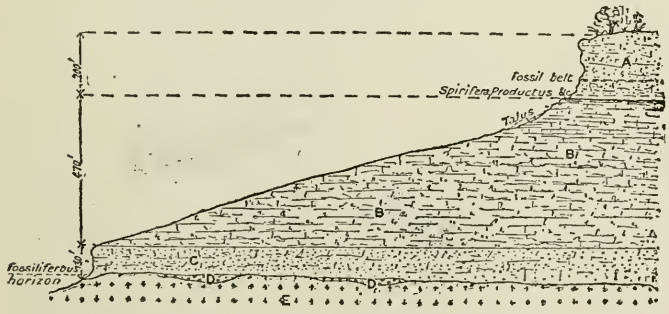
(*b*) *Permo-Carboniferous.*—This is represented by a thick capping of coarse and fine sandstones, mudstones, and shales of Upper Marine age.

The maximum thickness of the beds, occurring some two miles south-east of Yalwal, is 1,000 feet, and the general thickness varies from 600 to 800 feet.

The strata fall naturally into three divisions (see sketch) :—

(1) Lower.
(2) Middle.
(3) Upper.

Section of Sandstone Cap near Yalwal.



A. Upper hard belt of sandstone.
B. Middle belt of soft shales, sandstones, &c. ; almost barren of fossils.
C. Lower hard belt of sandstone.
D. Conglomerate.
E. Granite.

(*a*) *Lower Beds.*—These consist of hard belts of sandstone varying from 25 to 200 feet in thickness.

The basal beds lie upon patches of conglomerate, and consist for the greater part of coarse and hard sandstones, brownish-black, red, yellow, and white in colour. Intercalated with these are soft white sandstones and mudstones containing numerous plant impressions.

The cementing material consists generally of red and yellow oxides of iron, with traces of manganese oxide.

Numerous fossil remains occur in the lowest of the beds.

The conglomerates, which are very patchy, and appear to occupy local hollows once existing in the underlying formations, are composed of granite and quartz pebbles.

(*b*) *Middle Beds.*—These comprise a mass of soft sandstones, mudstones, and carbonaceous shales, weathering into gentle land slopes.

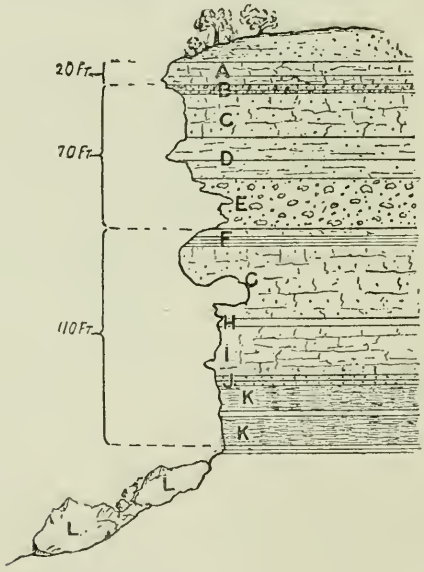
The members of this series are frequently full of whitish micaceous material, and are almost barren of fossil remains.

(*c*) *Upper Beds.*—These consist of very coarse sandstones lying upon fine shales, and passing above into alternating grits and conglomerates.

The maximum thickness is 200 feet in the immediate vicinity of Yalwal. The lower shales are frequently black by reason of much carbonaceous matter present.

One of the shale beds is eighteen inches in thickness, and is composed of masses of *Productus* and *Spirifers* remains held loosely together by soft cement.

Sketch Section of Upper Portion of Upper Marine Sandstone Cliffs, at Yalwal.
Top of cliff 1,050 feet above Danjera Creek.



White sandstone.....
Red and Yellow sandstone.....
Black carbonaceous .....
Sandstones and Shales.....

Reference.

A. Coarse unfossiliferous sandstone.
B. Thin beds of conglomerate. Casts of *Spirifera.*
C. Coarse sandstone.
D. Red sandstone with *Spirifera.*
E. Conglomerate, consisting of large quartzite pebbles and granite slate, quartz, &c.
F. Sandstone filled with *Productus* and *Spirifera.*
G. Coarse sandstone with alum deposits.
H. Fossil horizon.
I. Soft black sandstones.
J. 16 inch band, thick with *Productus,* &c.
K. Carbonaceous shales.
L. Talus blocks.

The alternating fossil shales and coarse barren sandstones indicate rapid deposition with periods of more settled conditions when fossils flourished to such an extent as to form an integral part of the strata.

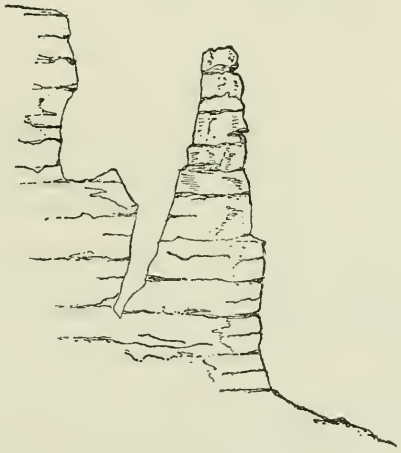
The conglomerates and grits consist of well rounded pebbles of rhyolites, granites, porphyries, and quartzites, and express the amount of degradation that the older strata were subjected to.

On superficial examination, the whole series presents lithological features analagous to those seen in the Hawkesbury sandstone of Sydney and its environments.

The Hawkesbury sandstone indeed forms the summits of the Cambewarra hills, just across the Shoalhaven.

Huge outlines of this upper series occur frequently. One represented below, and named the Chimney Stack, is 130 feet high, and but three yards in breadth at the summit.

"The Chimney Stack."



The fossils obtained from these sandstones have been named as follows, by Mr. W. S. Dun, Palæontologist to the survey :—

I. Lower Series.

Chænomya.
Platyschisma oculum. *J. de C. Sby.*
Spirifera. Sp. indeterminate.
,, tasmaniensis.
Martiniopsis subradiata. (Young).
Dielasma sp. indeterminate.
Mourlonia strzeleckiana. *Morris* (?).
Goniatites (Agathicras) micromphalum. (*Morris.*)
Martiniopsis oviformis. *McCoy.*
Aviculopecten cf. subquinquelineatus. *McCoy.*

II. Upper Series.

Martiniopsis oviformis. *McCoy.*
Productus Crachythærus. *G. Sby.* (very abundant).
Spirifera tasmaniensis. *G. Sby.* (Young).
Dielasma inversa. De Kon. Sp.
Spirifer duodecimcostata. *McCoy.*
,, convolutus. De Kon. =S. vespertilio. *G. Sby.*
Protoretepora ampla, *var.* Woodsi. *Eth. fil.*
Pachydomus pusillus. *McCoy.*
Spirifera, very indistinct, may be S. duodecimcostata. *McCoy.*
(This occurred at the summit of the cliffs near "The Gap.")

At Grassy Gully the basal beds contained :—

Platyschisma oculum. *J. de C. Sby.*
Pleurophorus gregarius. *Eth. fil.*
Spirifera duodecimcostata. *McCoy.*

(3.) *Devonian.*

This formation underlies the whole of the cap of Upper Marine sandstone.

The general trend of these older rocks is approximately that of the main divide of the Colony, viz., north and south. Small variations from this meridional direction occur, causing the strike to vary between N.N.E. and S.S.W., N. 10° W. and S. 10° E.

The dips, however, are exceedingly variable, the whole district having been thrown into a series of folds.

As will be seen on the appended map of Yalwal, there is evidence of a syncline in the centre of the field.

Lepidodendron beds, grits, and contemporaneous lavas occupy the upper part of this syncline.

The conglomerates found in the Jinkbilly Creek, which have a decided dip to the W.N.W. at 45°, are very possibly represented at the opposite side of the syncline by what is known as the Buck Reef, possessing a variable dip, but almost invariably in an easterly direction.

Conglomerates similar to the Jinkbilly variety occur some seven or eight miles above Yalwal along the Danjera.

Evidence of sharp folding occurs near the mouth of the Ettrema Creek. Originally, perfect arches stretched across the whole width of the creek at this spot. These have been partially removed by atmospheric agencies.

Of the rocks composing this Devonian series, highly siliceous varieties, consisting almost solely of quartz grains, are the most common. Generally they are finely laminated, but at times occurring in beds from twelve to eighteen inches in thickness.

With these are associated curly and siliceous slates, mudstones, spotted slates, and quartzites.

Higher up in the series are conglomerates in various stages of alteration. The pebbles are well rounded, and consist, for the most part, of fine-grained quartzites and claystones.

Intercalated with them are mudstones, shales, and claystones.

These pass upwards into felsite and basic lavas with tuffs, grits, sandstones, and fossil shales.

Eruptive Rocks.

(*a*) Rhyolite and dolerite lavas.

(1.) Field relations.—These lavas are so closely associated that they are here considered together, in so far as their field relations are concerned.

They persist in a N.N.E. and S.S.W. direction, over a distance exceeding twelve miles. What their further extension north and south may be, I am unable to say.

To the N.E. of Grassy Gully, on both banks of the Shoalhaven River, the rhyolites abut on the stream in precipitous manner.

Thence southwards, through Grassy Gully, the basic and acid lavas may be traced to the Upper Marine sandstone.

Reappearing at Yalwal Creek, the rhyolite is subordinate in amount to the dolerite, occurring only in small patches.

Here, however, the basic lavas make a great display, occupying almost the whole of Mackenzie's Station. These, however, appear to lie above the main rhyolite sheet.

The line of continuity of the lavas has also here been broken by the granitic intrusion.

Five or six miles above Yalwal, the associated rhyolites and dolerites appear to the south of the granitic masses, and then stretch for miles along the Upper Danjera, the rhyolites showing out beneath the Upper Marine sandstone as huge inaccessible cliffs, and the dolerites flanking them as steep wooded slopes.

The largest basic sheet is eight to ten chains in width, and may be traced for miles along the Danjera.

Beneath this again, in the bed of the creek, a second rhyolite outcrop occurs.

The acid lavas are pierced by the red granite in a remarkable manner, the intruding granite forming, throughout the rhyolite mass, an anastomosing system of lenticular veins and threads. The coarser rock partakes more of the nature of a huge apophysis than a boss, and roughly approximates to the strike of the rhyolite, piercing it in the manner above described for a distance exceeding two miles.

In Portion 1, Parish Yalwal, a small contemporaneous rhyolite occurs. It is of very limited extent, being some six chains in width and about 500 yards in length. It appears to have been intruded by one of the dolerite sills of the locality, and occurs among a great number of basic flows.

Contemporaneously with the more important *Lepidodendron* beds, several acid and basic lava flows occurred, accompanied by tuffs.

In Fletcher's paddocks, to the east of the Jinkbilly Creek, a similar condition of things obtains.

The great development of the dolerite sheets may be inferred from a glance at the map.

In some of the patches marked on the map as "dolerite lavas and tuffs, with associated sedimentary rocks," as many as a dozen basic sheets occur in less than a quarter of a mile traverse across the strike of these beds. These alternate with the *Lepidodendron* shales, felsite tuffs, tuffaceous mudstones, &c.

(2.) *Structures observable in the Field.*

(*a*) Rhyolites.

These possess conspicuous flow-structure. Well developed complicated flow-contortion markings are also common, imparting to the rocks the appearance of intensely folded laminated strata.

At Grassy Gully, the surfaces of the flow structure are persistently straight for considerable distances. In the process of weathering, these have become divisional planes, and the similarity to tilted laminated rocks is very pronounced.

Here, also, a certain amount of crushing is observable locally, the fragments being cemented by silica. These rhyolite breccias possibly bear some connection with the movements which caused the Grassy Gully reefs.

Along the Upper Danjera, porphyritic felspars are plentiful. Around these the flow structure is well shown, the felspars giving to the rhyolite an appearance similar to the "eye" structures of certain rocks.

The bands generally weather out in alternate black and white tints. Many of the black bands are not continuous in the lavas south of Yalwal as they are at Grassy Gully, but appear in the form of flattened spindles and cylinders with drawn-out ends.

The rock also develops locally as a black flinty-looking mass, filled with white inclusions.

A most interesting feature is the occurrence of large spherulites, varying in size from a pin's head to subspherical and ellipsoidal bodies two inches in diameter. The flow structure passes uninterruptedly through them. Concentric structure is plainly visible in some of the individual spherulites.

These interesting structures are described in rhyolites from other localities.

From Pambula nodular felsites have been described.*

Banded rhyolites occur at Bulladelah, containing spherulites over an inch in diameter. These belong to the Permo-Carboniferous.†

The spherulitic rhyolites of Yellowstone Park,** The Channel Islands,†† Hungary,‡ and other localities,‡‡ have been described in detail.

For the discrimination of structures, these rhyolites should be studied in the creek exposures. Here the selective action of the water has exposed their peculiarities. In the mass they are obscured, owing to the apparent homogeneity of the rock in fresh fractures, and its characteristically decomposed nature.

(*b*) *Dolerites.*—These consist of a series of dark-greenish black rocks, of high specific gravity, exhibiting most decided vesicular structure. The vesicles are frequently filled with products of decomposition, causing the rocks to become amygdaloids. The amygdules consist of soft chloritic products, quartz, calcite, and epidote. Calcite and chlorite are the most common of these secondary minerals.

The rocks have suffered great decomposition, long strings of epidote and serpentine crossing the rock frequently.

Very vesicular types occur to the immediate south-east of the cemetery, the east side of Sawpit Gully, and in front of the Public School.

Copper, associated with abundant zinc blende, iron, and arsenical pyrites, has been found in one of the dolerite flows. The occurrence is three miles above the village.

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* J. E. Carne. Ann. Rept. Dept. Mines N.S. Wales for 1896, pp. 111, 112.

† E. F. Pittman, Min. Res. N.S. Wales, 1901, p. 416.

** Iddings, vii Ann. Rept. U.S. Geol. Survey, 1888, 249-295.

†† J. Parkinson, Q.J.G.S., 1893, liv, 101-118.

‡ Cole and Butler, Q.J.G.S. 1892, xlviii, pp. 438-445 and references.

‡‡ Harker, Petrology for Students, 2nd Ed., 1897, p. 159.

(2.) *Intrusive dolerites.*

These possess great similarity to the contemporaneous basic lavas. They are generally fine-grained, greenish, and very compact rocks, devoid of vesicular structure.

It is probable that they are closely related in age to the higher members of the Devonian contemporaneous flows. They appear to transgress the bedding planes of the associated strata.

3. *Granites and microgranites (acid porphyries).*

The area occupied by the acid eruptives, as also their probable age, has been referred to in the notes on the general geology.

The occurrences are mostly of the nature of vertical bosses and huge tongues of quartz felspar porphyry. The main central mass may, however, be of the nature of a boss which has tilted the surrounding strata.

The rocks consist of red granites, quartz and felspar porphyries (microgranites), and aplite veins.

The granite is of medium coarseness, and is composed, essentially, of quartz and red felspar. Ferro-magnesian constituents are conspicuous by their absence. When present, they are of the nature of biotite or chlorite.

The porphyries consist of crystalline quartz and felspar in a pink granular base of the same minerals, the crystals being decidedly porphyritic towards the base. The quartz is of the smoky variety.

The unaltered quartzes, with their perfect contours set in a pink matrix, the latter only just discernible as granular in hand specimens, present a very fine appearance.

Miarolitic structure is well shown in a few varieties, the druses being very plentiful, the quartz and felspar being perfectly crystallised in the cavities.

The granitic and micro-granitic structures appear to shade off into each other by every gradation. As a rule, however, the granitic structure is confined to the more central portions of the larger masses.

Five or six miles above Yalwal the rock is typically a fine-grained granite, red in colour and miarolitic in character.

The porphyries of the Danjera Creek frequently weather out into pinnacle forms. As they become more granitic in character, typical granite weathering obtains, the sharp pinnacles giving place to dome-shaped hills.

About three miles above the village the rock is darker in colour, and is split up into huge slabs or tables by a uniform system of jointings possessing a south-east dip at 30°.

In Crawford, Johnson, and Hamilton Gullies, opposite the Homeward Bound battery, the rock approximates more to the quartz-felspar porphyries than the granites. The miarolitic structure is well marked.

The rock in the Yalwal Creek is also partly plutonic, and partly hypabyssal in habit.

Both varieties contain crystals of quartz; are almost devoid of ferro-magnesian constituents; and are crossed by a series of narrow aplite veins, probably representing segregation into cracks before final consolidation had set in.

It is here, along the road to Grassy Gully, that the finest examples of the porphyries occur.

In the great mass occupying the whole of the lower four or five miles of the Bundundah (Right Arm) Creek, the rock posseses the same high acid percentage as the Danjera and Yalwal Creek granites, but the appearance of the rock is rather different.

At Silver Dell a fine granular base of quartz and felspar is present with quartz more or less in crystal form scattered throughout the mass, and imparting a semi-porphyritic character to the rock.

This granite has a dark vitreous appearance, owing to the great amount of cairngorm present.

A system of vertical jointings crosses this mass. These fissures are sometimes filled with greenish material, which appears to have permeated the country rock for a few inches distance from the fissures.

Zincblende and pyrites occur in abundance in these fissures, and are associated with silver and copper.

The amount of decomposition the granites have undergone is remarkable. It is difficult to secure a piece that will stand the process of preparation for microscopical examination. The felspars have become so kaolinised as to have lost almost all trace of cohesion, and in places the igneous nature of the rock is obscured.

The granite masses exposed in the Danjera and Yalwal Creeks by the partial removal of the Upper Marine sandstone cap, are identically the same as the granite eminences of the Permo-Carboniferous landscape, actual summits of which still lie beneath the sandstone.

Ever since that period the porous sandstone cap has readily permitted surface waters to attack the granite, without allowing the crust so decomposed to be removed. This would account for the generally rotten state of the granites, with the exception of that occurring at the bases of the deeper gullies.

Petrological Notes on some Yalwal Rocks.

The Basic Rocks.—An examination was made of specimens numbered 4,434, 4,436, 4,437, 4,439, 4,440, 4,442, 4,444, and 4,445 in the official register of rock specimens.

They represent rocks gathered from various portions of the field. In hand specimens they appear as greenish black compact rocks, varying from fine-grained basaltic varieties to coarse dolerites, and they may be grouped together as ophitic dolerites.

The base consists of lath-shaped felspars, with decomposed granular augite, iron ores, and needles of apatite. At times masses of exceedingly small felspars occur. The ground mass is generally finely holocrystalline. A glassy residuum, however, may have been present in certain instances, but owing to the great decomposition present, it is difficult to ascertain its existence.

Phenocrysts of felspar are rare, but in sections like 4,445, two crops of plagioclase are plainly visible, representing both intratelluric and effusive stages. The felspars are mostly of basic varieties, and are lath-like in habit. One slide represents large irregularly shaped phenocrysts, the contours being due to interpenetration growths. The first crop is represented by moderately sized plagioclase idiomorphs showing polysynthetic twinning. Broad twinning bands are present. Extinction angles, measured from the traces of the twinning planes, varied between 25° and 30°. This points probably to a basic variety, such as labradorite.

The second crop consists of abundant small lath-shaped forms.

Small idiomorphs at times appear partly enveloped by iron ores.

The ferromagnesian constituents are represented by augite, which is present both as phenocrysts and as grains in the base. All the members of the first crop are moulded on the felspars, thus giving rise to the ophitic

structure (Plate IX). Under the influences of decomposition, the phenocrysts appear to be granular, but examination under crossed nicols proves the masses connecting the felspars to be in optical continuity.

In the coarsest dolerite examined some of the augite automorphs are as much as $\frac{1}{2}$ and $\frac{3}{4}$ inch in length, and contain as many as a score of felspar crystals in one individual.

These rocks are very difficult to examine in detail, the original structures being masked by alteration products.

The felspars are changed to opaque products, through kaolinization.

The augites are corroded, and appear as grains or strings, or irregularly shaped masses, greenish and brownish-green in colour. Serpentine and chloritic products are invariably present. Long strings of the former traverse the body of the rock. At times the serpentinous products form concentric radial fringes in the amygdules, after the fashion of agate structures. The angite also, in conjunction with the plagioclase, alters to saussuritic products. Epidote is abundantly represented in field examination, and calcite occupies the majority of the original rock cavities, and shows the characteristic rhombohedral clearage and bright polarisation colours.

Ilmenite is well represented in the base. The Grassy Gully dolerites show squarish to rectangularly shaped iron ores, and decomposition is sometimes seen taking place along traces of cleavage planes. One mass, resulting from alteration of the ilmenite, posseses high refractive index, is transparent, and shows pinks and greens of high order under crossed nicols. This variety of leucoxene may be related to sphene. Inclusions of apatite also occur in the ilmenite. Secondary quartz is also common.

The Rhyolites, as determined by examination of rock specimens, numbered 4,429, 4,430, 4,432.

These were selected from lava flows along the Danjera Creek and Grassy Gully,† and they represent rocks yellowish-brown to blackish in colour, showing marked fluidal and spherulitic structures.

Large porphyritic crystals of felspar are plentiful, scattered through a very fine base. Associated with the porphyritic felspar are biotite flakes much decomposed.

These phenocrysts represent the intratelluric phase of crystallisation. The felspars are generally rectangular, but at times show corrosion by the magma. Polysynthetic twinning is common. The twinning bands are narrow, and at times the extinction is slightly undulose. This may be due to excessively fine twinning. The felspar is probably an acid variety of plagioclase.

Peculiar forms of twinning occur in some of the felspars of the older crystallisation. Opposite quadrants extinguish and brighten simultaneously in polarised light (Plate X). The appearance is possibly due to Baveno twinning. Inclusions also occur which are opaque and white, and may be due to the decomposition of ilmenite.

The ground mass of the rocks shows under crossed nicols the peculiar dappled appearance of crypto-crystalline aggregates. Flow structures are invariably present as straight or wavy lines. Less frequently, they present all the appearance of minute foldings with sharp anticlines and synclines.

Perlitic structure is well shown between the straight lines of flow.

The "flow" phenomena are specially well marked round the felspar automorphs, the appearance being similar to the "eye" structure noticeable in certain rocks.

Spherulites were not observed in the perlitic specimens, but in the rocks showing contorted fluxion phenomena, well-formed spherulitic growths

† For Grassy Gully rhyolites, see also J. B. Jaquet, *op. cit.*

occupied the interspaces between the lines of flow. These are well developed and microscopic in size. This is known as the microspherulitic structure.

Along the bent lines of flow themselves the radiate growths occur in abundance. They do not start from a number of independent centres to form distinct spherical growths linearly arranged, but radiate from the contorted lines of flow themselves as axes. This is the axiolitic structure of Zirkel.

The finest examples of microspherulites, however, occur in a homogeneous looking felsite, in hand specimens almost devoid of the porphyritic element. The microspherulites themselves occur as patches of irregular shape set in a felsitic base. Under-crossed nicols the dark brushes of the tiny growths are arranged collinearly.

Some of these microscopic radiate growths have been replaced by quartz, secondary quartz is also very common, forming along lines of flow.

Iron oxide is common in red and brown stains.

Ilmenite is present, though not in great quantity. It is generally decomposed. Small zircons also occur.

Large spherulites are fairly common. They vary in diameter from $\frac{1}{8}$th to 2 inches. The lines of flow pass uninterruptedly through them.

The examination of these rocks points to a former vitrophyric condition, in which phenocrysts of an earlier period of consolidation occurred in a glassy base representing the effusive stage.

The base is cryptocrystalline (felsophyric) at present, but the great development of perlitic cracks points to former glassy conditions.

Divitrification in the case of the contorted flow-structure appears to have taken place as spherulitic and axiolitic growths. The non-association of the spherulites and perlitic growths is interesting.

Microgranites.—Determined by examination of rock specimens 4,428, 4,434.

The specimens described were chosen as typical examples from the Yalwal Creek, and the country rock of the lodes at Bundundah Creek.

These rocks are red to reddish brown in colour, and show idiomorphs of quartz and felspar plentifully scattered through a very fine but holocrystalline base. The individuals of this base are composed of quartz and felspar grains, which are roughly equidimensional, and show a tendency, in some instances, especially in the case of the felspars, to be idiomorphic. This matrix may then be described as hypidiomorphic granular. The rock is hypabyssal in character, and may be described as a quartz-felspar porphyry.

In the narrow aplitic tongues which pierce alike the dolerites and the rhyolites, the rock represents an almost simultaneous microscopic separation out of quartz and felspar. This is the micropegmatitic or granophyric structure. A decided tendency to graphic growth is observable in rocks from other portions of the field, the quartz showing characteristic six-sided skeleton crystals, the central portions being occupied by felspar.

The felspar of the first generation is represented by rectangular phenocrysts, $\frac{1}{3}$ to $\frac{3}{4}$ inch in length, much decomposed, and generally present as opaque white and pink kaolinised masses. In less decomposed examples, multiple twinning is frequently observed, pointing to plagioclase as the dominant felspar.

In rare instances, albite and pericline types of twinning, associated with quartz intergrowths, are exhibited by the same crystal. The crystals are coloured red and yellow with iron oxide, the edges being deeply stained at times.

The felspar of the effusive stage is clearer than that of the earlier periods, and has a great tendency to form granophyric growths with the later quartz.

The quartz of the earlier stage of crystallisation occurs as bihexahedral phenocrysts. Corrosion has, however, been set up, and inlets of the magma occur in the peripheries of the crystals These phenocrysts vary from $\frac{1}{16}$ to $\frac{1}{8}$ inch in diameter, measured across the hexagonal sections. Inclusions are numerous, and arranged linearly. The base becomes much finer in texture as it nears the point of contact with these quartz idiomorphs.

Ferro-magnesian material is present as a few irregularly distributed green patches. It is pleochroic, and probably represents some decomposition product of biotite. Iron ores occur as ilmenite, weathering into leucoxene. Iron oxide is abundant, sometimes as inclusions in the viridite. Apatite is present.

A noticeable feature in the Yalwal granites is the absence of large felspar phenocrysts so common in the granitic rocks of New England.

Another point of interest is that while the granites, or granitites, of New South Wales are generally basic in character, containing (especially in the porphyritic types) abundant plagioclase, biotite, hornblende, sphene, apatite, and zircons, the Yalwal rock is characterised by its high silica percentage and its lack of basic constituents.

Rock specimen, 4,429.—This is a rock much like spherulitic pitchstone in hand specimens.

The bulk of the rock is composed of concentric growths about $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter.

The field evidence points to a tuffaceous origin.

Under the microscope, these structures are seen to consist of tiny flakes of hæmatite, with smaller quantities of limonite arranged concentrically, the long axes of the flakes being set parallel to the peripheries of the circles.

The base appears to be cryptocrystalline. The spheroidal growths are possibly expressions of weathering.

Economic Geology.

1.—*Alluvial Mining.*

The whole of the lower course of the Danjera and its continuance to the Shoalhaven as the Yalwal Creek contains alluvial gold, though not in great quantities

The majority of the gold found is fine in nature.

The whole course of the Yalwal Creek, as also many miles of the lower portion of the Shoalhaven, has been leased for dredging purposes

The gold of the Danjera and Yalwal Creeks, being in a fine state of division, is difficult to recover by sluicing operations.

Saw-pit Gully (Plate III), a small watercourse draining the eastern part of the gold-bearing area, has, at various times, yielded a fair amount of gold.

The alluvial containing the gold consists of angular fragments of the associated Devonian strata and very large blocks of Upper Marine sandstone.

The gully is not of great age, the sandstone cap having but recently been worn through at this point, and the alluvial deposits of the stream postdate the degradation of the sandstone covering.

As the gold is, therefore, derived from the adjacent claims of the Caledonian, Bismarck, Usher, and Golden Quarry, one would naturally expect

to find it but slightly rounded. It is generally coarse at this spot, one nugget weighing as much as 3 or 4 ounces. Other specimens varied in weight from 15 dwt. to 3 ounces.

Gold to the value of £2,500 was extracted from the Sawpit alluvial in 1893.

Alluvial has also been worked at Grassy Gully, its discovery leading to the working of the Grassy Gully Reef.

(2.) *The Lodes.*

As far as at present known, no reefs with decided walls exist in the Yalwal district.

In 1883, Mr. Pittman,† Government Geologist, declared that the ore deposits were of the nature of impregnations in stratified rocks. Since then mining developments have done nothing further to indicate the existence of pronounced fissure veins.

The gold-bearing area proper is confined to a hard belt of rocks immediately south of the village of Yalwal, and occupies both east and west banks of the creek.

These sediments consist of quartzites, conglomerates altered in places to quartzites, schists and slates.

The greater number of workings occur on the eastern bank of the creek, those on the western bank being confined to a few blocks known as the Eclipse, Pinnacle, and Poor Man Claims.

Three large belts of conglomerate pass through the field.

One "makes" strongly through the Usher tunnel, across the Saw-pit Gully, and into the Golden Crown property.

Another and parallel belt emerges from the sandstone immediately to the east of the Homeward Bound open cut, thence through the eastern pegs of the Pioneer, across the Danjera Creek, as the "Buck Reef," Plate III, or "Mother Lode," and clean through the Pinnacle and Eclipse leases, leaving the latter property at the mouth of the No. 2 tunnel. Thence, with varying dip, it passes to the north.

These conglomerates consist of black and grey quartzite, slate and quartz pebbles, set in a fine siliceous cement. They have been so altered in places as to have lost all trace of their pebbly origin. The first stage in their metamorphism consisted in the reduction of the whole to a quartzite in which the matrix and enclosed pebbles are almost indistinguishable.

Further stages are marked by masses of impure quartz, all traces of pebbles having vanished.

The softer strata between the conglomerates, as also those beneath them have been subjected to great crushing.

All this line of country is auriferous in a greater or lesser degree.

Large low grade deposits have been found closely associated with the conglomerates, *e.g.* Golden Crown, Usher, Hidden Treasure, Pinnacle, and Eclipse claims.

These conglomerates are probably connected with less altered beds in the Jinkbilly Creek. In the latter locality, epigenetic agencies have not had nearly so much influence on the strata, the nature of the pebbles and the cement, as also the strike and dip being evident at a glance. Curious alteration products are observable in the Golden Crown and Pinnacle claims. A rock of felsitic appearance occurs in the lodes of these properties in great abundance, being as much as ten yards in width near the surface of the

† Annual Report, Department of Mines, 1883, 159–160. *Vide* also, The Mineral Resources of N. S. Wales, 1901, p. 59.

South end of Homeward Bound Open Cut.

Pinnacle workings. It is, however, so soft that it can be scratched with the finger nail. It is whitish, brownish, and occasionally bright green in colour, being also in the latter case translucent, and of an oily appearance resembling pargasite.

Rarely it has the appearance of certain dolomites. In these cases it contains small radial aggregates.

Threads and lenticular bunches of quartz intersect it in all directions. Frequently also it is intimately associated with a dense, hard, siliceous rock resembling impure quartz.

Throughout these soft and hard silicate masses, large bunches of pyrites are capriciously distributed; there are also innumerable black strings representing oxidised pyrites.

Below the water level these formations contain huge masses of iron and arsenical pyrites, with white quartz In the case of the Pinnacle, the Eclipse, and the Golden Crown, the "formation" is crossed with numerous slides, some of which have been mistaken for true reef walls, as "Reynolds' Hanging Wall"—a slide in the Eclipse.

The Homeward Bound, Pioneer, and Star leases represent the western portion of the auriferous area. The former two are worked as large "open cuts" or quarries, all the quarried matter passing through the batteries.

References to the diagrams shew the quarries to be contained in quartzites, iron-stained slates, possessing various dips, and traversed by slides.

The mass of strata worked for gold in the west is intersected with innumerable quartz-veins or "stringers."

Although these properties are not so intimately related to the conglomerates as the eastern leases, they may nevertheless be considered as associated with them, inasmuch as their strike is almost coincident with the western belt of conglomerate, and their distance apart is insignificant.

In the Caledonian property, a closer approximation to true veins is found. The strata here vary in dip from 30°–60° to the north-west and west-north-west. Narrow veins of chalcedonic quartz run across the "combs" of the country. These, however, appear to have no depth, and, as far as at present proved, pinch in and out with wonderful rapidity.

The quartz of the field is generally very impure, being for the greater part of the chalcedonic variety, bluish to grayish in colour, and weathering into products having the appearance of whitish and yellow clays.

Opaque white quartz occurs associated with the pyritic masses of the conglomerate area.

The bulk of the soft material in the lodes appears to be derived from crushing of the strata.

The only important constituent of the lodes is gold.

It is marked by its occurrence in an extremely fine state of division. Similar occurrences are noted from Wyalong* and Pambula.†

Free gold occurs in the oxidised zones, but, as far as at present known, not in the sulphide zones. The pyrites of the sulphide zone yield on assay from 2 to 24 dwt. of gold per ton, the bulk of the mineral being of poor quality, rarely exceeding 2 dwt. per ton. This information was supplied by the mining men of the field.

The surface gold was contained in a variety of gossan, and was at times coarse in nature. Throughout the lode the gold occurs in irregularly distributed patches, and as films coating divisional rock planes. Very often no trace of the gold is to be seen in the solid rock between these gold-covered jointings.

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* J. A. Watt, Min. Resources, No. 5, p. 19. † J. E. Carne, Ann. Rpt. Dept. Mines, 1896, p. 116.

From this it seems evident that the sulphides contained the gold, and that surface waters reduced the auriferous pyrites to iron-oxide, free gold, and various soluble products.

At Grassy Gully the auriferous belts occur in felsite formations, traversed by thin quartz veins. Gold is found in a finely-divided state on the joint faces of the crushed felsite.

Three miles to the north of Yalwal, along the Yalwal Creek, the granite has surrounded a mass of basic rock. A white variety of quartz occurs in the granite near the junction of the two rocks. Silver has been found at this spot.

In the Right Arm (Bundundah) Creek, silver, lead, and copper have been mined for in granite.

The minerals occur in joints and fissures, which are traceable over considerable distances in an approximately north and south direction.

The vein material is at times greenish in colour.

Copper associated with zinc-blende and pyrites has also been found in the dolerites. Granitic dykes occur in close proximity to this lode.

The Genesis of the Deposits.

It is very probable that the intrusion of the Carboniferous (?) granites and micro-granites formed the most important factor in the folding of the Yalwal district.

These foldings were accompanied by intense local deformations

The axes of the foldings coincide with the strike of the beds, and the ruptures forming the lodes appear to follow the lines of greatest weakness. This is plainly seen in the Homeward Bound, Pioneer, Pinnacle, Eclipse, and other auriferous belts.

The cooling of the eruptive masses was also attended with crushing owing to the shrinkage of the mass.

The soft green-and-white lode products are, doubtless, due to the crushing of the softer strata against the harder belts, the nature of the material so derived being modified subsequently by mineralised waters.

Innumerable shrinkage cracks were developed in the strata, which had been twisted into sharp anticlines and synclines. Into these cracks quartz, auriferous pyrites, and other minerals were introduced by circulating waters.

The faces of the joints and faults were also charged with gold in the same manner.

The Caledonian deposits admit of a similar explanation, although here the "reefs," which are larger than the "stringers" of the Homeward Bound, do not follow the strike of the country, but break across it. They are, however, very limited in extent, and represent slight ruptures in the harder and more compact rocks, which crossing the "combs" of the country, were allowed to remain open until filled with chalcedonic quartz. It is very probable that these lenticular masses of chalcedonic quartz, containing rich gold patches may exist in other portions of this belt of country. A single tunnel cannot be expected to prove the ground entirely, as these small veins pinch in and out with great rapidity.

Similar conditions appear to have obtained at Grassy Gully. Here, however, the disturbed rocks consist of rhyolites and dolerites.

Grassy Gully reef appears to lie along a line of crushed rhyolite. The fragments resulting from crushing have been cemented by quartz, and the breccia itself is traversed by very small quartz veins.

The general appearance is that of local crushing, which took place along meridional lines.

This brecciation in certain cases may be due to the opening of fissures, and subsequent movement of the walls on one another.

Other occurrences are at times suggestive of "crush breccias," the fragments being subsequently cemented by silica and tiny veins of chalcedonic quartz developed throughout the mass.

The gold occurs in joints throughout the formation of crushed rhyolite, and is found both in the igneous rock and in the quartz.*

It is associated with pyrites and occurs in a very fine state of division, as at Yalwal. Rich specimens at times consist of rhyolite masses having thin coats of gold on one or more sides determined by rock joints, the rock between the cleavages being absolutely barren of the auriferous material.

It appears then that the Yalwal district was much contorted, that the contortion or movement was of considerable duration, during which fissures opened along the lines of maximum weakness (the axes of the folds) and were closed again, a grinding action ensuing, the outward and visible signs of which are the various lode formations; and that innumerable cracks sent their tiny ramifications through the mass as a result of the above mentioned forces and also of the shrinkage due to settling down of the disturbing agents; and that highly mineralised waters circulating through the mass deposited gold bound up in pyrites.

Description of Mining Properties.

The Pinnacle.

This claim, known also as No. 1, lies on the north and south line of the crushed formation that follows the belts of conglomerate. The lode is exceedingly variable in width, and is apparently due to the metamorphism of the associated conglomerates and intercalated beds. The alteration products at times have the appearance of felsites. They can, however, be scratched with the finger nail. Quartz occurs throughout this "formation" generally as white opaque varieties, in irregular patches, as though filling cracks in the soft crushed mass. Throughout the lode, also, black oxidised pyritic bunches occur in the same irregular manner. These, at about a depth of 100 feet from the cap of the lode, make into large bunches of pyrites. Their assay value is very low. In other places the formation consists of a dense, opaque, iron-stained siliceous material, resembling an impure quartz.

The country consists of mudstones, shales, quartzites, slates, and siliceous schists, having a general north-east dip, varying from 30° to 50°. This dip, however, exhibits numerous variations from the general north-east direction, indicative of minor crumplings superimposed on a general fold.

The methods of working adopted consisted of excavating the top to a width of nearly two chains, and a corresponding length along the line of strike, and a depth of about fifty feet. A floor was here left, and beneath this again another large excavation was made, connected with the upper workings by passes. This bottom chamber narrows at about 100 feet below the cap to eleven yards in width. Two tunnels are driven into it from the hillside, near the battery.

The upper one is some 100 feet in length, and passes through beds containing *Lepidodendra*.

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* J. B. Jaquet, Records Geol. Survey, 1900, vii., p. 17.

The lower one, some 60 yards in length, is the main outlet for the ore passing to the battery, and is cut out of the creek bluffs at 45 feet above the water. This lower tunnel has been continued through the workings for another 100 feet to prove the country west of the lode.

The battery in use consists of fifteen head of stampers, 800 lb. each in weight. It is attached by gearing to a Robey engine of 20 h.p., worked with a multi-tubular boiler. A Jacques rock-breaker is employed, as also automatic feeders. Two Berdan pans and Huntingdon mills were originally in use, but have since been discarded.

The gold returns were furnished by Mr. J. Sievewright, and represent a few of the better yields from this, the pioneer property of the field.

Gold Returns.

Date.	Tons crushed.	Oz. of gold.
May–Sept., 1872	.....	118
Nov., 1872–March, 1873	80	120
1874	220	330
1875–1878	Returns lost.	700 (?)
May–Dec., 1878	315	382
Jan.–Feb., 1879	53	115
April–July, 1880	280	670
March–Nov., 1881	1,406	282
Feb.–Oct., 1882	341	69
Total from 1872–1882	... .	2,786

The Eclipse.

This property, also known as No. 2, joins the Pinnacle to the south, and appears to be continuous with it. The workings of both properties open freely into each other, and give the idea of a series of gigantic caves, superimposed one above the other, and connected by narrow passages.

The uppermost workings exist (as described for the Pinnacle) in the form of an open cut, terminated below by an irregularly shaped floor. Below this, however, still larger caverns exist, with attached side caverns, and below this again another series of chambers.

Some of these are as much as fifty or sixty feet in height, fifty feet in length, and thirty to forty feet in width. The total depth of the Eclipse series of chambers is 160 or 170 feet. Recently mining operations have been revived in this property, and the top floor, in the immediate vicinity of "Reynolds' Hanging Wall" (a joint-face mistaken for a true fissure wall), has been blown away by explosives, and exposes a cavern 100 feet in depth. Some of the individual shots used in blasting the material, forming the floor between the uppermost and middle chambers, brought away over 100 tons of stone.

The whole of the material left by stoping operations presents a dangerous appearance. Fragments of rock, several tons in weight, project loosely from the walls. Under the present management, however, these are being removed, and the workings will henceforth be safe to work in.

Pinnacle and Eclipse Claims. From the North.

What has been said concerning the Pinnacle applies with equal force to the Eclipse, except the presence of the soft-green crushed material. The country is harder in the Eclipse than in the neighbouring property.

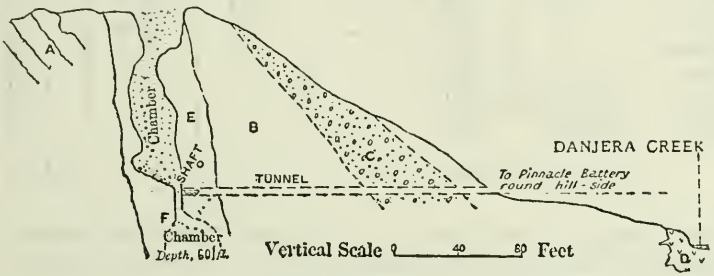
The workings are also much deeper.

A large chamber, fifty-five feet deep, and of almost equal length, exists in the Eclipse below the bottom level of the Pinnacle. Two shafts, also some sixty feet deep, were sunk in the lower level. Much of the work was carried on in solid pyrites and opaque white quartz.

A small tunnel has been driven near the top of the workings, to afford an outlet for the ore of the open cut.

A lower tunnel was driven in the hill-side to prove the northern side of the property.

Sketch Section Illustrating the Method of Working "The Eclipse Mine."



Reference.

A.—Contorted slates.
B.—Hard siliceous rocks.
C.—Altered conglomerates.
D.—Intrusive dolerite.
E.—Much oxidised pyrites.
F.—Much arsenical and iron pyrites.

Note.—The Pinnacle tunnel, as indicated above, is projected into the same plane as the Eclipse workings. There are no defined boundaries to the lode as shewn in the section.

An almost circular route was taken with the open cut as goal.

This tunnel was used to convey the ore to the battery.

At present, however, the two properties (Pinnacle and Eclipse) have been amalgamated, being the property of Mr. Alex. Hay. The stone in the vicinity of Reynolds' Hanging Wall is broken down, passing over a large tip in its fall into the Pinnacle claim, whence it is trucked along the lower tunnel (Pinnacle) to the Eclipse battery, as the Pinnacle battery, a larger and much better plant, is slightly out of repair.

The Eclipse battery [Plate VI] consists of ten head of stampers, each 600 lb. in weight. Punched screens and copper amalgamating plates are in use. The battery is connected with a portable Robey engine, of ten horse-power, by bevelled-gearing.

The tailings passed into settling pits, and were then turned into vats to undergo the cyanide process. Two leaching vats were used, each ten feet in diameter, with a working depth of four feet and a capacity of nine tons. This plant is not used at present.

Good crushings have been obtained from the mine during the last few months.

The following gold yields of the Eclipse Mine were kindly supplied by Mr. John Maclean, of Nowra, and date from 15th May, 1878, to 14th July, 1889 :—

Date.	Tons Crushed.	Oz. of Gold.	Amount.
RESULTS AS PER MINT PROCEEDS DURING SUFFOLK'S TRIBUTE.			
			£ s. d.
14 May, 1878, to 30 December, 1878	.....	.....	155 1 0
14 March, 1879, to 15 April, 1879	.....	.....	92 19 0
RESULTS OBTAINED BY ECLIPSE GOLD-MINING CO.			
October, 1879, to 22 December, 1879	161	264·73	886 14 0
14 February to 23 December, 1880	376	573·84	1,895 3 0
22 July ,, 22 ,, 1881	1,034	801·00	2,795 3 0
4 March ,, 10 August, 1882	851	307·66	1,015 10 0
27 June ,, ——— (?) 1883	160	230·00	578 13 0
4 April ,, ——— (?) 1884	100	95·06	330 0 0
10 November ,, ——— (?) 1885	.....	.....	120 19 0
6 August ,, ——— (?) 1886	.....	.....	502 2 0
14 June ,, 14 December, 1887	.....	.....	1,751 11 0
20 January ,, 14 November, 1888	.....	.....	703 7 0
27 March ,, 26 July, 1889	.....	.....	964 0 0
Total till July, 1889	.....	.....	£11,543 2 0

The following averages represent a nine months' continuous crushing, *i.e.*, the averages of the monthly percentages of the total amount of stone mined and treated during that period (prior to 1889) :—

	s.	d.	
Mining	1	$8\frac{1}{2}$	per ton.
Crushing	1	$7\frac{1}{2}$	,,
Fuel	0	$9\frac{3}{8}$	,,
Stores	1	$0\frac{1}{12}$	,,
Approximately (mine to Mint)	5	$2\frac{11}{24}$	

The Pioneer Claim.—This property consists of three open cuts of large size, a lower tunnel 950 feet in length, an upper tunnel some 450 feet in length, and a fine battery situated about twenty-five feet above creek level.

After being worked for a while at the surface, shafts were sunk on supposed reefs. The gold, however, being discovered in "stringers" throughout the country, it was found advisable to adopt the quarry or open cut system.

In all there are three open cuts, Nos. 1, 2, and 3.

Nos. 1 and 2 open cuts are about fifty to sixty feet deep in very unsettled country, the strata having suffered much from crushing.

The material from these open cuts was conveyed to the battery by means of a short tunnel driven in from the hill-side, and by a pass connecting with the main tunnel.

No. 3 open cut is larger than Nos. 1 and 2. It is continuous with the Homeward Bound workings, and its floor is about fifteen feet lower than that of its neighbour. It is also of more recent date than the other Pioneer workings. The ground is also more settled, the beds having a general west-north-west to north-west dip, varying from 30° to 40°.

A fault runs along the eastern boundary and disappears in the wall about half-way along the quarry's length. The beds of this open cut may be seen to cross the north and north-west ends of the Homeward Bound open cut.

PIONEER BATTERY. FROM THE NORTH.

Mr. J. Hanson purchased this property in 1890, and became sole proprietor He drove a tunnel into the hill from a spot not far removed from the site of the present battery. This tunnel was driven with the double object of conveying the stone to the battery and proving the existence of any lodes.

Its course is straight for some 8 chains, thence under the open cuts its course is sinuous. It is 130 feet below the floor of No. 3 open cut, and passes connect it with the various workings.

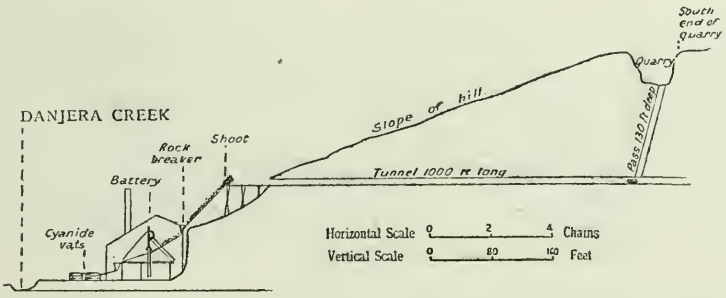
The strata passed through consists of curly and siliceous slates, quartzites, etc. Small quartz veins cross the directions of the bedding but appear to be only slightly auriferous.

On completion of the tunnel in 1891, a forty-head battery was erected (Plate VII). Each stamper is 900 lb. in weight, and works at from sixty-five to seventy drops per minute. Punched screens, and copper plates (twelve to fifteen feet in length) are in use. A giant rock-breaker, fifteen inches by nine inches, is employed as also Challenge automatic feeders.

The battery is driven by gearing from the engine, which is of the compound condensing type of eighty I.H.P., and giving seventy revolutions per minute.

Two boilers are in use, made by the Otis Co. of Melbourne from Bateox and Wilcox pattern.

Sketch Section of "Pioneer" Workings, illustrating the method of sending ore to mill and cyanide plant.



The diagram illustrates the method of conveyance of ore to the battery. The stone is sent down a pass 130 feet in depth to trucks running on a slightly inclined tramway to a shoot, whence the ore is conducted into the rock-breaker and thence to the battery.

The cyanide plant which was erected in February, 1898, is worked on the New Zealand plan, and consists of three solution tanks. Two of these are each of fifteen feet diameter and six feet working depth. The other is ten feet in diameter and six feet in working depth. The leaching vats are five in number. Four of these are twenty feet each in diameter and of four feet working depth. The capacity of each is sixty tons. The remaining vat is fifteen feet in diameter and of forty tons capacity. These vats are fixed on a concrete foundation. No upward current of water is used whereby to minimise the deleterious effects of the slimes, but instead Spitzkastens are attached to the end of the amalgamating tables.

Lime is employed as the neutralising agent, $2\frac{1}{2}$ to 5 lb. being used to each ton of tailings. Three precipitation boxes are used to recover the gold. A complete assay plant is attached to the battery.

The gold returns for individual years are not available, but the total amount won from the inception of mining operations until the end of August, 1895, was £24,000.

In 1896, 9,664 tons of stone were crushed for a yield of 454 ounces of smelted gold.

Since that time very little mining has been carried on.

Homeward Bound Claim.

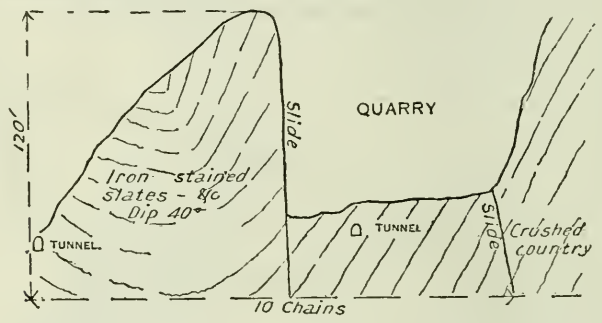
This property is the only one on the field that has been worked continuously for the past three years.

The property consists of two gold leases, containing nearly fifteen acres and two mining tenements.

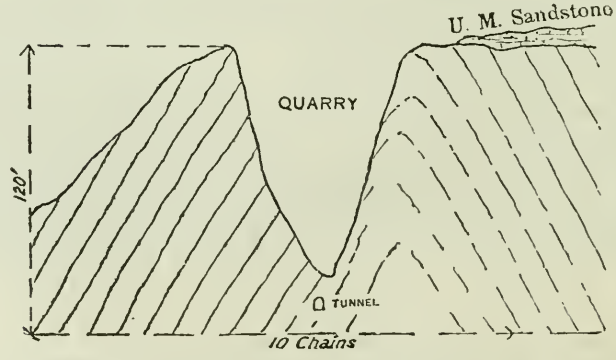
About the year 1872 the surface of the present Homeward Bound Claim was prospected for gold. Shafts were then sunk on supposed quartz veins and stoping afterwards carried on to such an extent that the various workings became connected. The cap was then broken down, and mining operations have since been confined to the formation of a large open cut.

A glance at the plan and sketch sections of the workings reveals the varying dips of the strata.

Sketch Sections across "Homeward Bound" Co.'s Quarry.



Section from W. to E. through middle of quarry; dip slightly exaggerated; no reefs are visible.



N.N.W. and S.S.E. section through S.W. corner of quarry, showing possible anticline, signs of which are visible from the south; no reefs showing.

At the north-west and north-east extremities, the prominent dips noticeable in the "Pioneer claim" obtain, viz., north-west to west-north-west at angles varying from thirty to forty degrees. The dip then rises rapidly to the south-west and near a fault on the western boundary is north-west at sixty-five degrees.

At the extreme south-west portion there is evidence of a small anticline among the slaty rocks, the beds at this spot dipping in an easterly direction at thirty degrees.

A slide (fault) occurs alongside the eastern wall of the open cut. This also passes into the "Pioneer" claim and has influenced the beds there. The ground immediately to the east of this fault is much crushed, the rock dips not being recognisable.

The open cut is rectangular in plan. At the surface the length is about four chains, and the width three chains.

The batter of the open cut is about sixty degrees, although in places slides have caused the walls to assume an almost perpendicular appearance.

An anticline occurs between the open cut and the mouth of the tunnel.

The open cut is 100 feet in depth at the southern end, but tapers away to the north owing to the hill slope.

Throughout the whole of the excavation there is no sign of a decided reef, the gold occurring in small quartz "stringers" scattered in all directions throughout the country.

In 1891 a tunnel was driven into the hillside to facilitate the conveyance of the ore to the battery below.

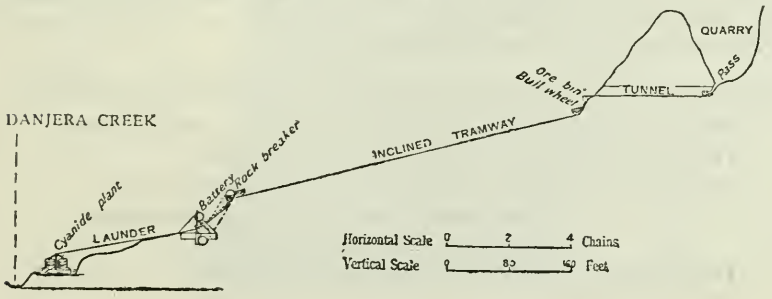
The walls are broken down and trucked to one of the several passes in the floor of the workings; thence they pass to the tunnel twenty feet below and are trucked by horses to the ore bin. Here a bull wheel enables the trucks to be sent down an inclined tramway by the force of gravitation alone.

The inclination of this tramline is from eleven to fifteen degrees, and its length is 200 yards. The stone is tipped into the rock-breaker and passes thence through automatic feeders into the battery.

The tailings are conveyed directly from the amalgamating plates by a launder to the cyanide plant.

This method of procedure is explained by the sketch section.

Sketch Section showing method of sending ore to battery by gravitation, "Homeward" Bound G.M. Co.



The battery in use consists of forty head of stampers, each 900 lb. in weight, also ten head of stampers, each 700 lb. in weight. The average speed is seventy-two drops per minute. Punched screens (190 holes to the

inch) are in use and copper amalgamating plates. (Plate VIII.) The battery is driven by a horizontal, high pressure, non-condensing engine, having a cylinder of twenty inches diameter and a stroke of forty inches.

The two boilers are multitubular, twelve and fifteen feet respectively in length, and six and a half feet in diameter.

A Worthington Duplex pumping engine is employed.

The following notes on the cyanide plant were supplied by Mr. A. F. Mixner, General Manager of the "Homeward Bound" Gold-mining Company.

The vats (leaching) are nine in number having a total capacity of 350 tons. Five vats are of thirty tons, and four of fifty tons capacity.

The diameters are twelve and fifteen feet respectively and the working depth of all seven feet three inches.

Owing to the hilly character of the locality the plant had necessarily to be constructed with the solution vats and zinc precipitation boxes on the high ground, and by this arrangement the solution has to be pumped to the zinc boxes for the extraction of the gold. The pump works the three solution valves (alkaline wash, strong and weak solutions) with the one piston, and the amount of solution required to be lifted is regulated with bye-passes connecting the delivery pipe and the collecting pumps, so that the solution running with the greatest strength governs the speed of the pump) and the bye-passes are opened to such a degree as to compensate for the suction of the other two. The tailings are conveyed to the cyanide plant by a wooden launder and iron pipe. From the main sand pipe. each vat is connected by a separate pipe leading into a distributor, the height of the sand launder being nine feet above the vats. Under the launder the solution pipes are placed, each vat having its own connection with the same, and in such a way that the solution can be either applied to the top or forced in from below, this being one of the advantages gained from the situation of the solution vats.

The solution connections are simplified by the arrangement of three-way valves leading from the main, and also a two way valve at the side of each vat, acting so as to divert the current of the solution either up or down into the vessel. This solution pipe is also connected with a three inch water main so that the water can be applied in a similar manner.

Great difficulty was at first experienced owing to the slimy nature of the pulp, and it has been found advantageous to apply an upward current of water whilst the vat is being filled. Thus the slimes are borne upwards over the vat rims, and a free leaching pulp remains.

The treatment.—The principle of the process is continuous percolation.

Filling takes place at the rate of one ton and a half per hour.
Draining water from tailings occupies eight hours.
Treatment with alkaline wash occupies twenty-two hours.
,, ,, strong solution occupies seventy-two hours.
,, ,, weak solution occupies ninety hours.
Draining after weak solution occupies eight hours.
Discharging residues occupies three to four hours.

The strength of the strong solution varies from ·26 to ·3 per cent. of potassium cyanide (KCY). That of the weak solution of potassium cyanide varies from ·14 to ·18 per cent.

HOMEWARD BOUND BATTERY AND CYANIDE PLANT.

The alkaline wash required is made up with ·8 lb. alkali to the ton of tailings treated. The effect of this wash is to neutralise the natural acidity of the tailings.

After the alkaline wash the strong solution is applied, and then the weak.

The clean-up is conducted in the ordinary manner by rubbing the deposit off the zinc filament, drying and roasting with ten per cent. of nitre, then fluxing with borax, soda, bicarbonate and manganese dioxide, under which treatment a rough bullion of a value of fifteen shillings per ounce results.

This is refined and is forwarded to the bank having an average value of about £3 per ounce, whereas the native gold of the mine is worth about £3 5s. per ounce. The alloy is silver.

Generally speaking the amenability of the ore to cyanide treatment allows of a very cheap method of treatment. This smallness of cost is further accentuated by the fact of the porous nature of the material acted on, allowing a coarse (120 holes to the inch) screen to be used.

The precipitation in the cyanide treatment is by zinc filaments. Four boxes are in use, each 13 feet 6 inches long, 2 feet 6½ inches wide, and 2 feet 2 inches working depth. There are nine working compartments in each.

The consumption of zinc per ton of tailings actually treated is ·75 lb.

The average percentage of extraction by amalgamation is 40 to 44 per cent., and the extraction of gold from the tailings by cyaniding ranges from 66 to 84 per cent., according to the value of the material under treatment, and this value varies from 30 grains to 4 dwt. of fine gold per ton.

The plant is almost automatic, one lad in each shift doing all the work.

A considerable space has been devoted to this cyanide treatment at the Homeward Bound, but the simplicity and cheapness of treatment coupled with the fact that the cyanide plant saved the mine when recovery by amalgamation was rapidly approximating to a negligible quantity, justifies the extra space given up to its description.

The percentage of extractions is:—Milling, from 15 to 47 per cent.; cyaniding, from 50 to 84 per cent. The cost of treatment per ton at this mine is as follows:—

	s.	d.
Mining	2	0
Explosives		4·68
Fuel	1	6
General Stores		1·90
Up-keeps and Repairs		9·16
Milling	1	7
Cyaniding (including smelting, refining, assaying, etc.)	3	0
Total	9	4·74

The foregoing figures are averaged from 30,000 tons of stone treated. Twenty-eight men are employed in the mine; in the mill three men and three boys, three stokers, and two others.

Gold returns of Homeward Bound Mine.

(1.) From crushings dating from 1882–1889, with a 10-head battery.

	Silver.	Gold.
	£ s. d.	£ s. d.
June 1—August 29, 1882	6 18 4	575 18 11
March 4—December 20, 1883.....	29 12 3	2,555 17 9
January 6—October 3, 1884	26 1 6	2,051 7 6
May 8—October 3, 1885	68 17 5	5,133 11 9
January 15—December 24, 1886 ..	.....	3,564 7 0
February 18—December 6, 1887...	60 13 11	6,105 10 0
January 10—December 6, 1888 ...	25 14 3	5,478 2 11
February 7—July 24, 1889	.....	2,196 2 3
Totals	216 18 8	27,650 18 1
		216 18 8
Total	.....	27,867 16 9

(2.) Later returns, dating from 1890–1900.

June, 1890—April, 1897 (from August, 1894—February, 1897, the mine was not worked owing to litigation) 9,804 oz 10 dwt. 20 grs. of gold were recovered. Average value £3 4s. 9d. per oz.

From September, 1898, to December, 1900, 37,898 tons crushed, and 13,371 tons cyanided. The gold won by amalgamation amounted to 3,723 oz. 2 dwt. 20 grs. (Standard gold) 762 oz. of silver were also won.

From cyaniding, 1,570 oz. 5 dwt. 15 grs. of gold recovered at value of £4,229 8s. 3d.

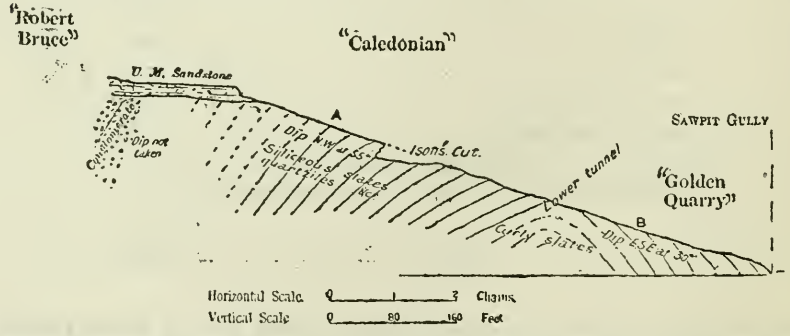
The Caledonian Property.

This is the claim from which all the sensational gold finds have come. The property is also known as G.L. 20, and is twelve acres in extent. The Permo-Carboniferous sandstone forms a cap over the whole claim except over a small patch at the north-west corner.

The workings consist of two tunnels, one being 100 yards in length, and a few open cuts about a couple of yards in width, varying in length from one to four chains, and in depth from ten to fifty feet.

It will thus be seen that the ground is by no means proved as yet.

Sketch.—Section across the Caledonian property from the Robert Bruce Claim E.S.E. to the Golden Quarry Claim and Sawpit Gully.



Note.—The ground from A to B shows numerous irregular fissures (especially near the summit of the anticline) filled with chalcedonic quartz.

The gold is confined to small chalcedonic quartz veins crossing the combs of the country. The enclosing strata consist of siliceous and curly slates, quartzites and conglomerates dipping north 60° west at angles varying from 15° to 65°.

In the lower tunnel the strata dip in opposite directions at the two ends of the drive. This shows the existence of an anticline immediately to the east of the workings.

The gold occurred in patches of exceptional richness, as explained by a perusal of the gold returns.

The open cuts, whence the gold was won, were driven on small veins. They are named as follows:—

1. *Sandeman's Cut.*—This is 100 feet in length, thirty feet in height, and having a direction of 220°.

The gold was found in "stringers" of bluish and whitish quartz of felsitic appearance. The underlay of the vein is about 10°.

2. *Underwood's Cut.*—This is one chain in length and about thirty feet in depth. Nearly £40,000 of gold were said to have been extracted hence.

3. *Ison's Cut.*—Occurs one chain north of Underwood's Cut. The length is some four chains, and it has a direction of 230°.

A line due north and south connects the mouths of the various cuts.

Gold Returns.—Only a few of the better returns were obtainable, the total amount of gold not being known—

	£
1892. (Three months' crushing)	3,500
1895. 27½ tons for 1,487 oz.	4,833
1895. 1¾ „ 750 „	2,438

Original company since that time obtained more than £6,000 worth of gold in a few months.

It is also stated that in the year 1895, 4 tons of stone yielded 1,664 oz. of gold.

The Star.

This claim was taken up in 1883 by a Nowra syndicate.

It occurs on a very rough sideling.

Three tunnels have been driven at various levels into the hillside, with an almost due east direction. They are driven as closely as possible to the Homeward Bound property, and they lie vertically one above the other.

The upper one is 200 feet in length and 400 feet above the creek, the middle 350 feet in length, and the lower 450 feet long.

This lower tunnel is driven almost at the creek level.

In the two upper drives a little gold was found.

The country consists of siliceous slates principally, that show an easterly dip. Small quartz veins cross the property.

This claim lay idle for years. In 1900 it was taken up by Mr. H. Martin, and subsequently amalgamated with other leases belonging to Mr. A. Hay.

In September, 1900, four tons of stone were crushed for a return of 5 oz. 7 dwt. per ton.

Shortly afterwards, a parcel of 100 tons was made up and crushed at the Pioneer battery. The yield was a little less than 10 dwt. per ton.

The Golden Crown.—This property, also known as G.L. 1., occurs in much altered country in close association with the conglomerate belts. An intrusive sheet of dolerite occurs immediately to the east.

The country has been subjected to great crushing and extreme silicification, the latter possibly through the agency of heated mineral waters.

The soft magnesian silicate rock with the appearance of felsite is of frequent occurrence. Here much of it occurs in patches of bright green translucent to almost transparent masses.

The workings consist of an open cut at the base of which is a shaft about ninety feet in depth. A tunnel nearly sixty-five yards in length was driven in the hill from Sawpit Gully to connect with the various workings.

Great quantities of pyrites occurred in the lower portions of the workings.

The Usher.

This property is known also as G.L. 17. It contains a tunnel 230 feet in length driven towards the western boundary of the lease. After passing through slates, a belt of soft conglomerate was encountered.

A shaft was also sunk on the hill side to a depth of forty feet. The mass of the material driven through consisted of oxidised pyrites, associated with quartz and conglomerate

The pyrites on assay are said to yield 24 dwt. per ton.

Golden Quarry (Nos. 1 and 2).

G.L. 27 and 28. Golden Quarry No. 1 has a shaft sunk thirty-three feet east of G.L. 19 and thirty-four feet deep. A cross-cut fourteen feet long was driven on a formation six feet in width.

A tunnel also 208 feet in length was driven west from the level of the gully.

In 1896, 113 tons of stone extracted from both claims were crushed for a yield of 188 oz. 8 dwt. of gold.

The Victory.

The country is much altered, intense silicification having occurred in the slates and other rocks. Many of the strata now consist of quartzites. A hard belt of country occurs in this claim which is being mined for gold. A tunnel has been driven through the property for a distance of 500 feet.

This property is situate between the Pioneer and Pinnacle Claims.

The Poor Man.

This claim was prospected for gold in 1880, and then taken up. The country consists of narrow belts of quartzites, slates, and shales, much bent, crushed, and faulted.

The workings consist of a large open cut, and a tunnel a couple of chains in length.

Gold was found on the faces of the rock joints. The occurrence of the metal was extremely irregular, as in the cases of the other Yalwal claims.

No account was kept of the better gold returns. In 1896, 311 tons of stone were crushed for 75¾ oz. of gold.

Other minor Properties.

These consist of properties, such as Baberton's lease, Sir Julian's Leg, The Albion, The Coolongatta, The Daydawn, and The Bruce.

Baberton's Lease—This occurs in crushed and faulted quartzites and shales to the north-west of the Poor Man. An open cut was started.

The Albion (G.L. 26).—This contains a drive, 130 feet long, and also a cross-cut. Much pyritic material was found here.

The Coolangatta (G.L. 39) gave good prospects, and contained much pyrites.

The Daydawn (G.L 23).—A tunnel, 100 feet long, has been driven in at the level of Sawpit Gully. Pyrites occurred in great abundance, with an assay value of 8 dwt.

The Bruce (G.L. 18 and 19).—This property adjoins the Homeward Bound to the east. Very little work has been done. The country is similar to that of the Homeward Bound.

In 1896 a parcel of 18 tons was crushed for 16¼ oz. of gold.

B. Grassy Gully.

(*a*) *Grassy Gully Mine.*—In 1895 the lease was taken up by Moffat. In January, 1900, it passed into the hands of the Grassy Gully Gold-mining Company, with Mr. P. Durkin as mining manager.

The workings consist of three shafts. The principal one was sunk to 185 feet in June, 1900.

At the 170 feet level a drive nineteen feet long was put in to the south.

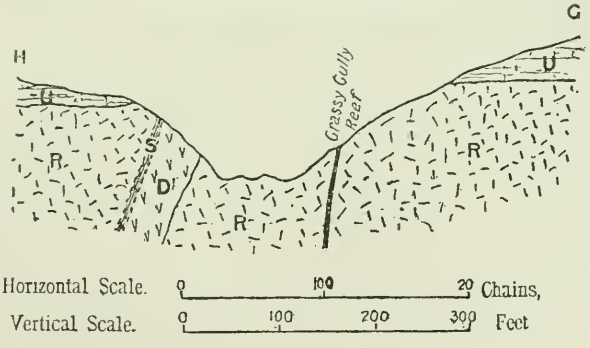
At the 140 feet level a drive twenty-three feet long was also put in to test the country to the south, and at the seventy-eight feet level also a sixty-eight feet long drive was put in (to the south).

These workings are all on the main lode.

No. 2 shaft was sunk on a parallel lode, twenty-five yards to the east of the main lode. This is sixty-six feet in depth. Both "reefs" underlay fifteen feet in every 100 feet to the west. Their strike is almost true north and south.

No. 3 shaft is sixty-seven feet deep. It occurs on the main lode, and has the same underlay as Nos. 1 and 2.

Section on Line H.G. on Map of Grassy Gully Gold-field.



Reference.

U Upper marine sandstone.
D Dolerite.
S Tuffaceous rocks.
R Rhyolite.

Everything sent up from the process of sinking and driving is passed through the battery. The average width worked is from four to five feet. The formation consists of crushed rhyolite, cemented by silica, and a so-called

"reef" of quartz traverses the breccia in places along its line of strike, varying in width from two to twelve inches. Gold occurs in the quartz, and also in joints throughout the crushed igneous rock.

The formation is five feet wide at the bottom of the shaft, and averages 11½ dwt. of gold per ton.

Sixty-five per cent. of the gold in the stone is recovered by the battery and vanners.

The battery consists of ten head of stampers, each weighing six hundredweight.

Punched screens (200 holes to the inch) and copper amalgamating plates are in use. The plant was erected in September 17th, 1900.

A Wilfley vanner is in use. According to Mr. P. Durkin, the capacity of this machine is from fifteen to twenty-four tons per day.

A cyanide plant is to be erected, capable of treating 100 tons per day.

It is expected that eighty-five per cent. of the gold in the tailings will be recovered by cyaniding.

Gold Returns.

Since June, 1898, the following gold yields have been reported:—

Tons treated.	oz. gold.	£	s.	d.
54·5	930⅕	3,744	9	2
49·4	344¾	1,395	17	2
77·6	181⅐	724	14	1

For the several months prior to 24th November, 1900, 500 tons were also crushed for a yield of 150 oz. free gold, and 4 tons concentrates, averaging 8 oz. per ton. Total, 182 oz.

Total from June, 1898, to November, 1900, 681½ tons, crushed for 1,638 oz. of gold.

(*b*) *Percival's Claim.*—This is almost in line with the main Grassy Gully Reef. It is, however, said to occur on the No. 2 lode, twenty-five yards east of the main lode.

The shaft is about seventy-five feet deep, and the gold is contained both in quartz and felsite.

No gold returns were obtained from this property.

APPENDIX I.

Extracts from W. B. Clarke's "Southern Gold-fields," p. 39–40.

. . . . Yalwal Creek consists of three branches, exclusive of Ettrema Creek. As to the auriferous indications of the Yalwal locality, I can only say, from twelve years intimate knowledge of it, that for several years back I considered it to develop more mineral indications than I had seen elsewhere ; and that from my first perusals of the descriptions given of the Turon geology, I felt such a strong conviction of its being auriferous, that during the last six months, I have said to many of the Shoalhaven settlers that, ere long, they should find gold much nearer home than they were aware of, and that as soon as they concluded their harvest I would direct them where to find it; and, accordingly, about three weeks ago, I got a gentleman who had some months' experience at the Turon to accompany me to Yalwal, and who, at one part of the locality said that, had I brought him there blindfolded, he would have declared he was on the Turon ranges. But from all I can learn, I have reason to conclude that most of the Yalwal geology and auriferous indications are more assimilated to those of the Braidwood diggings than any other, as most of its rocks consist of coarse red granite, with a good deal of the "conglomerate" in some parts, and interspersed with ranges of red earth, trap rock, and schist without much quartz, except in one of the creeks, where there are considerable rocks of rather a bastard kind. I have often regretted that Mr. Clarke, in his survey of the Shoalhaven, had not his attention directed to Yalwal. . . . . I have just returned from seeing the prospectors ; they have found less or more in every place they tried, except one, and rather more of what I conceive to be platina than gold, but some of which they cast away before I arrived there. . . . .

I have, &c.,

A. K. MACKAY,

J. R. Hardy, Esq., C. C. Lands. Commissioner of Crown Lands.

Extracts from W. B. Clarke, "Southern Gold-fields," pp. 42, 43, 44, 45, 250.

. . . . In that part of Tasmania, and in the country along Yalwal and the Clyde, Silurian slates bearing auriferous quartz veins undoubtedly occur ; and I have also detected abundance of auriferous pyrites, not only in the ferruginous schist, but in the quartzose rocks, and even in the granite of Yalwal, and from the decomposition of these auriferous rocks some gold has been set free in the alluvia. But the mass of the country consists of the rocks of the carboniferous formation, all the members of which may be distinguished, from the lower fossiliferous beds between the coast and Yerrirong Creek and sigillaria shales (in the Danjera Creek gullies). . . . . And, whilst poryphyries underlie the fossiliferous beds below the coal and overlie the gold-bearing rocks, the more recent igneous rocks have broken through the carboniferous formation, transmuted and covered it in various parts of the district, appearing in dykes and in overlying and prismatic masses. . . . . I do not doubt, therefore, that there is some gold to be yet found in the ravines, and all along the broken country between the mouth of the Yalwal Creek and the head of Mongarlow River ; but it occurs in iron pyrites mechanically united, and in thin quartz veins, which will require the processes of science for the extraction of the metal. The bearing of these remarks on the general capabilities of the Shoalhaven basin will be seen by reference to the Araluen district. . . . . ; but, knowing how necessary is the existence of uncovered auriferous rocks, or if covered, covered only by drift of a certain epoch, I could not, even in 1851, have searched the Yalwal country with any respect for my own opinion of it. . . . . I still incline to think that the drift, and the ferruginous schists and quartzose rocks of the Yalwal Peninsula, will not be found very rich in gold. Not till we have got well up on the table-land of Argyle and Murray, have we reason to conclude that an extensive gold-field can exist. No doubt in my mind remains, that though in Tasmania and in the Yalwal Peninsula the true auriferous slates, with the granites of a more recent date, occur beneath the overlying formations ; yet in both regions, alluvial gold can only be expected

in small quantity. Nevertheless, I am of opinion, that between the Sassafras Range and the eastern course of the Shoalhaven, an independent auriferous region does exist, but the value of it can only be determined by long and persevering researches. No sooner, however, do we reach the area of the grey hornblendic or syenitic granites, which are so well developed about Araluen, than gold becomes abundant, diminishing in quantity as we enter the quartziferous schists surrounding it, and becoming very scanty so soon as we come into contact, as in Yalwal Peninsula, with the covering sedimentary deposits of the carboniferous epoch. It has been before stated that the granite of Yalwal is not of that kind; it is rather a coarse pale pinkish rock of loose texture, and having little or no hornblende, with a small amount of mica and bihexahedral crystals of quartz. . . . . It may be mentioned, that on Talwal Creek, which is a Yalwal water, a lode of argentiferous galena was found in 1849, of which an analysis appeared in June of that year. The result gave a very high percentage of silver, but the analyst did not consider it likely to be payable.

Extract from page 250.

In the Yalwal Peninsula, as on Danjera Creek, the same rock† appears associated with Silurian shales and other members of the series, but all of which have been so transmuted by the trappean rocks, as to have become quartzites, or silicified into chalcedony or traversed by thin veins of quartz. This part of the Carboniferous formation has, therefore, undergone the same kind of metamorphosis which distinguishes the lower Palæozoic formation, on which it rests.

† Lower Carboniferous.

DESCRIPTION OF PLATES.

I. Frontispiece. View of Yalwal, looking north.

II. General view of Danjera Creek, looking south from the Pinnacle Claim. Pioneer and Homeward Bound Batteries in middle distance.

III. The Buck Reef. A metamorphosed belt of conglomerate. From the Pinnacle Tunnel.

IV. The Gap. Showing bluffs of upper marine sandstone.

V. Homeward Bound Open Cut. From the Pioneer Open Cut.

VI. Pinnacle and Eclipse Batteries. From the bridge, looking south-west.

VII. Pioneer Battery. From the north.

VIII. Homeward Bound Battery and Cyanide Plant. Looking south-east.

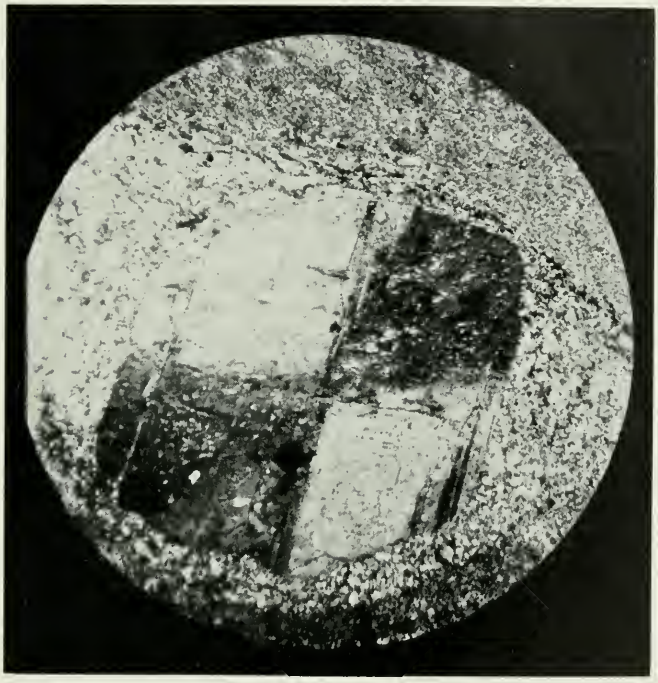
Microphotographs—

IX. Ophitic dolerite.

X. Peculiar Felspar Twinning.

Sydney: William Applegate Gullick, Government Printer.—1901.

Ophitic dolerite.



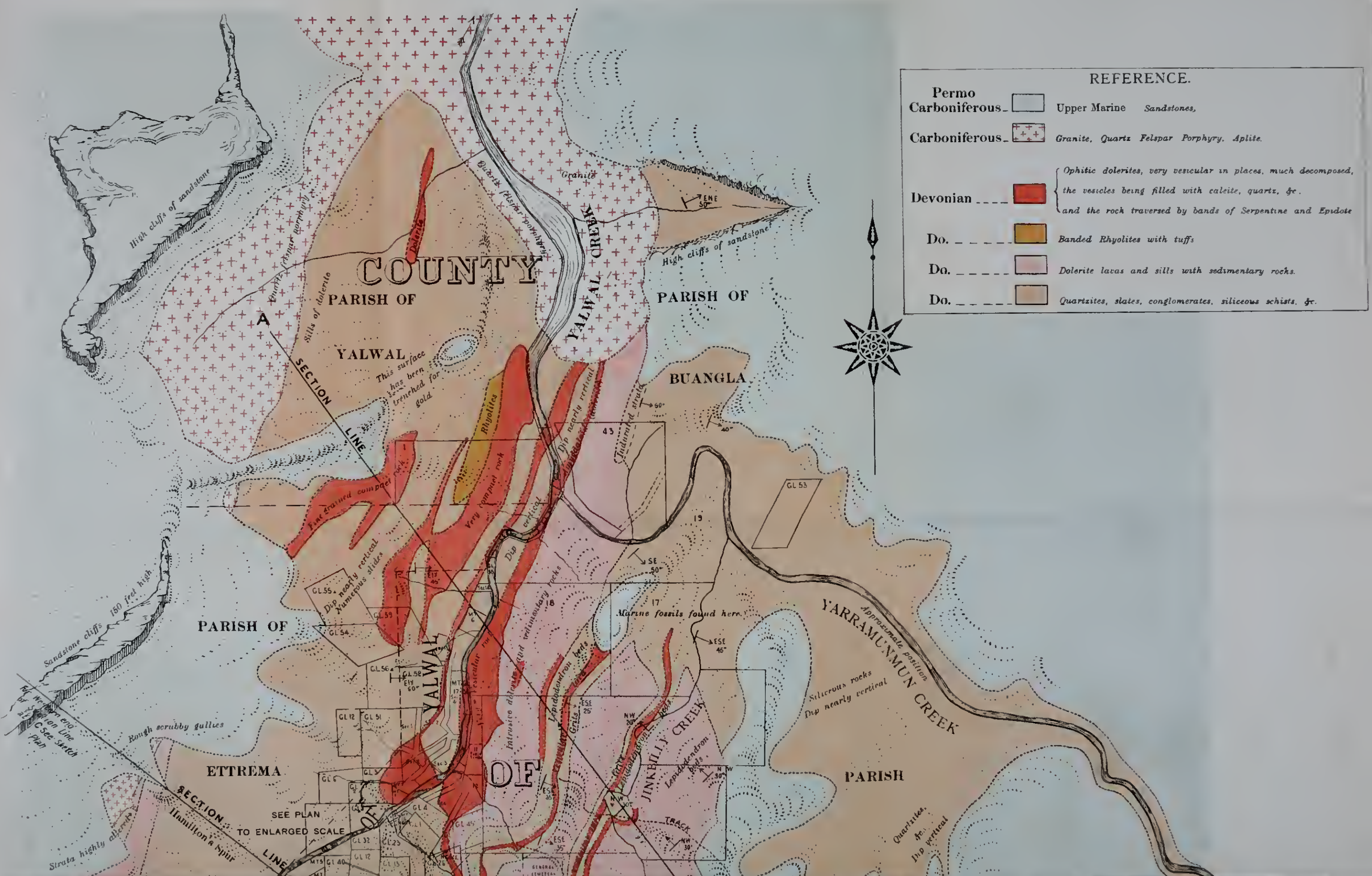
FELSPAR CRYSTAL IN RHYOLITE.

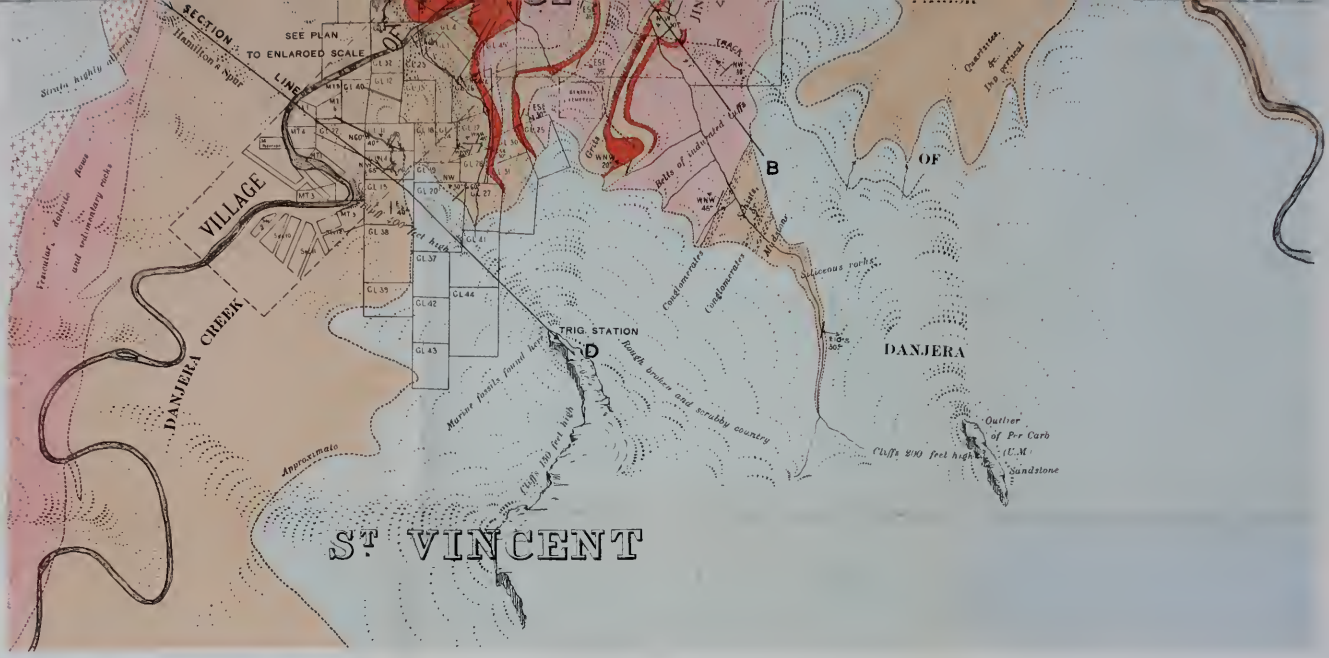
GEOLOGICAL MAP
OF THE
YALWAL GOLD FIELD

By E. C. ANDREWS, B.A., Geological Surveyor.

Prepared under the direction of E. F. PITTMAN, A.R.S.M., Government Geologist, Department of Mines and Agriculture, Sydney, 1900.

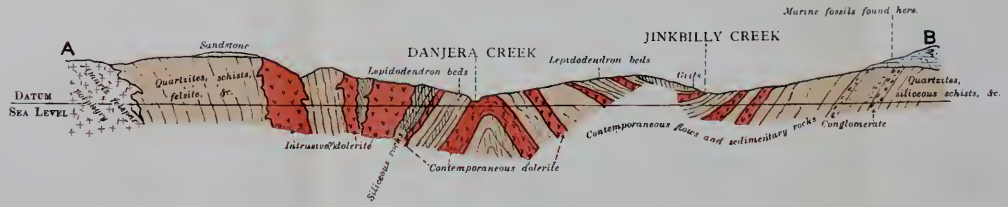
Scale 0 10 20 30 40 Chains





SECTIONS Horizontal Scale and Vertical Scale 0 10 20 30 40 Chains 2640 Feet

SECTION ON LINE AB



SECTION ON LINE CD

72912

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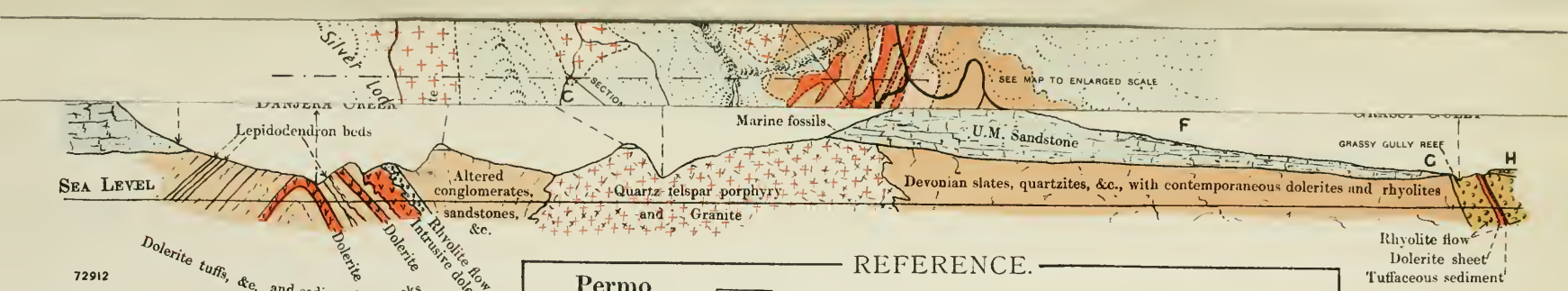
W. A. Gullick, Government Printer,
Sydney, N.S.W.



REFERENCE.

Permo Carboniferous		Upper Marine *Sandstones.*
Carboniferous		*Granite, Quartz Felspar Porphyry, Aplite.*
Devonian		*Ophitic dolerites, very vesicular in places, much decomposed, the vesicles being filled with calcite, quartz, &c., and the rock traversed by bands of Serpentine and Epidote.*
Do.		*Banded Rhyolites with tuffs.*
Do.		*Dolerite lavas and sills with sedimentary rocks.*
Do.		*Quartzites, slates, conglomerates, siliceous schists, &c.*

Photo-lithographed by W. A. Gullick, Government Printer, Sydney, N.S.W.

GEOLOGICAL SKETCH MAP

(With Section)

Of the country in the vicinity of

YALWAL

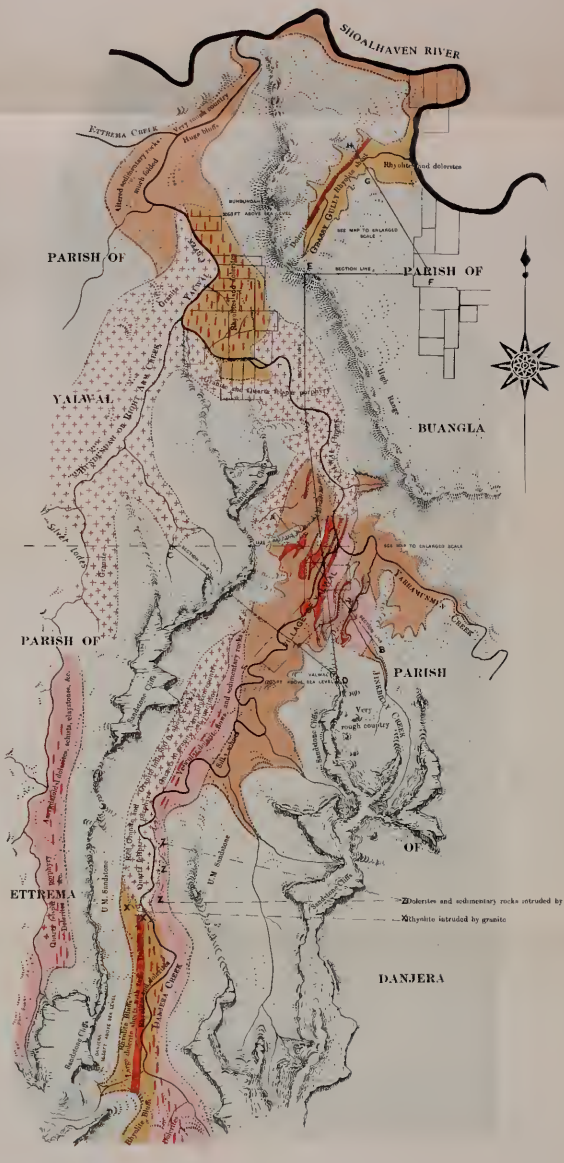
COUNTY OF St VINCENT

By E. C. Andrews, B.A., Geological Surveyor

Prepared under the direction of E. F. Pittman, A.R.S.M., Government Geologist.

Department of Mines and Agriculture, 1901.

Scale 0 — 40 — 80 — 120 — 160 Chains



SECTION ON LINE DEFGH

Horizontal Scale 0 — 40 — 80 Chains

Vertical Scale 0 — 1600 — 3200 Feet

REFERENCE.

Permo Carboniferous		Upper Marine *Sandstones.*
Carboniferous		*Granite, Quartz Felspar Porphyry, Aplite*
Devonian		*Ophitic dolerites, very vesicular in places, much decomposed, the vesicles being filled with calcite, quartz, &c., and the rock traversed by bands of Serpentine and Epidote*
Do.		*Banded Rhyolites with tuffs*
Do.		*Dolerite lavas and sills with sedimentary rocks*
Do.		*Quartzites, slates, conglomerates, siliceous schists, &c.*

Photo Lithographed by W. A. Gullick, Government Printer Sydney, N.S.W.

PLAN

Showing Gold Workings, &c., in the

VILLAGE OF YALWAL

Scale 0 4 8 **Chains**

72912

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Sydney, N.S.W.

GEOLOGICAL SKETCH MAP

Of the

GRASSY GULLY GOLD FIELD

By E. C. Andrews, B.A., Geological Surveyor

Scale 0 8 16 24 Chains

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